OFFICIAL PUBLICATION OF THE PROCEEDINGS AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

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DECEMBER 19, 1955
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AMERICAN DYESTUFF REPORTER

Devoted to Textile Chemistry
BLEACHING · DYEING · PRINTING · FINISHING

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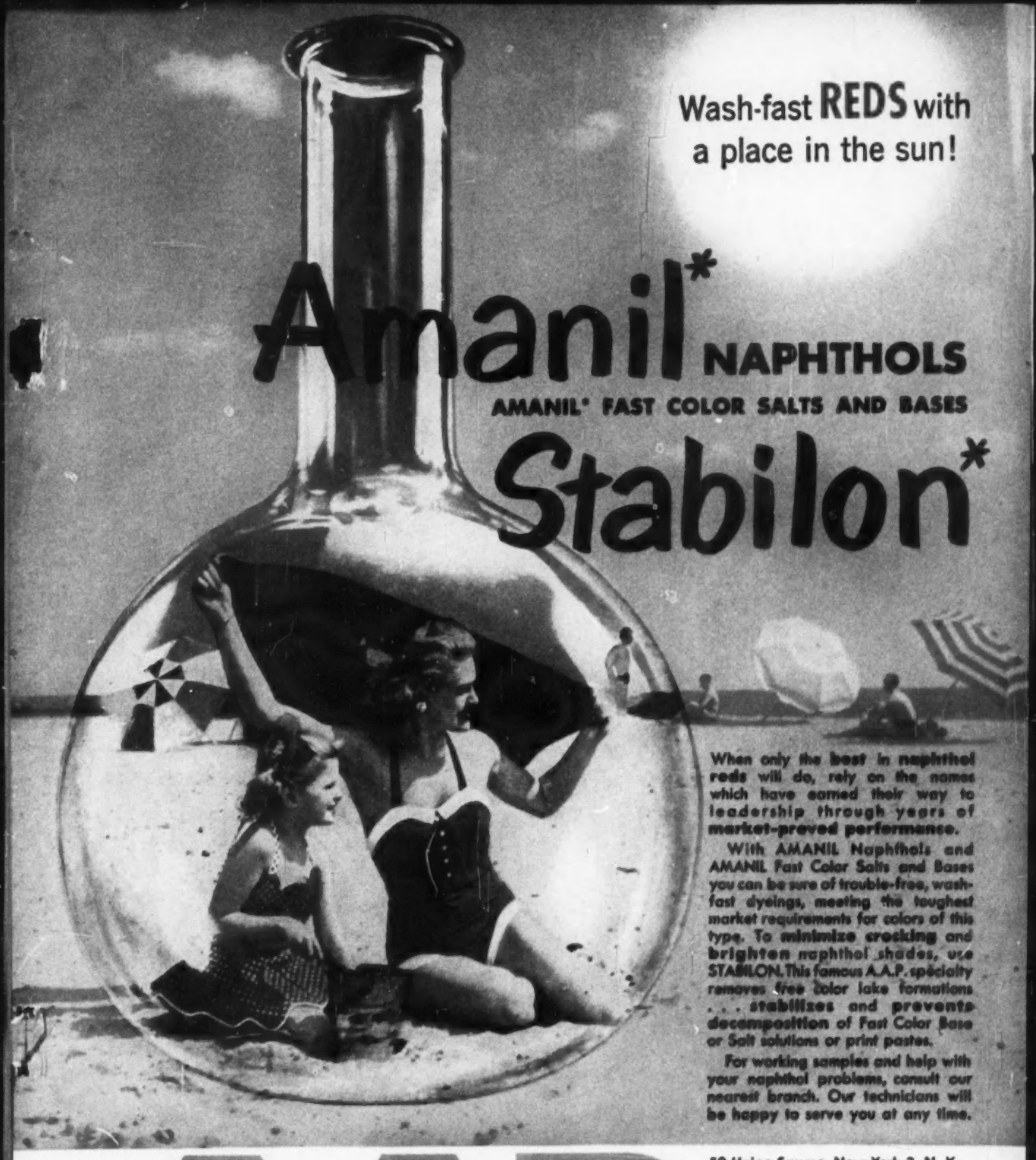

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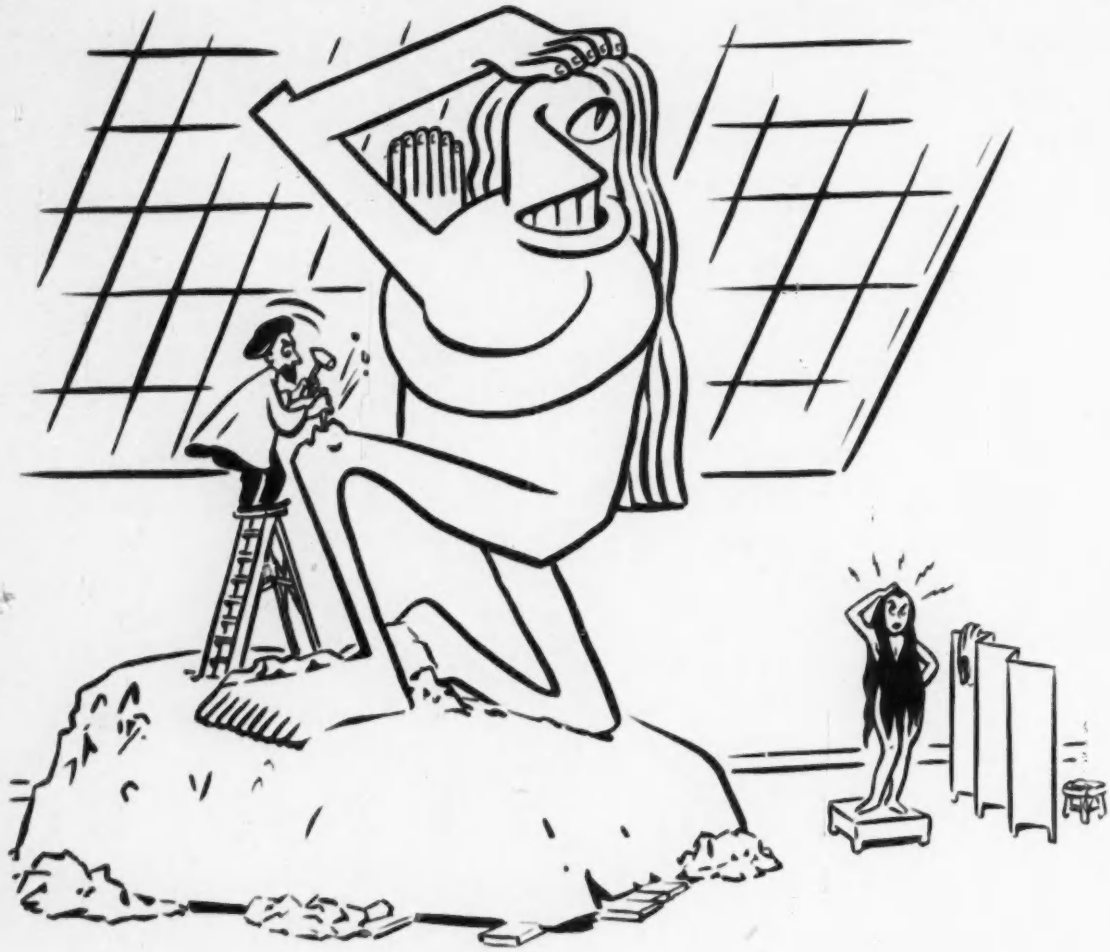

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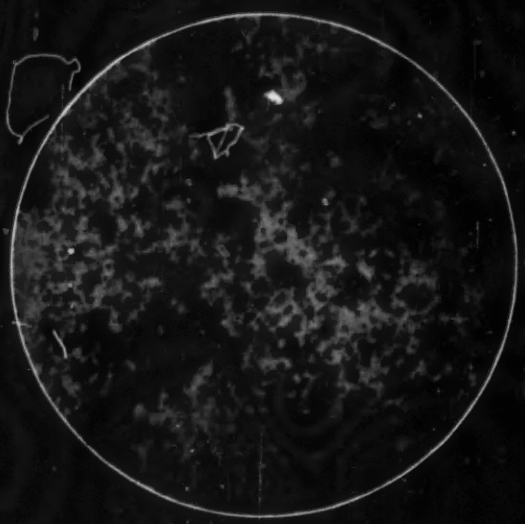
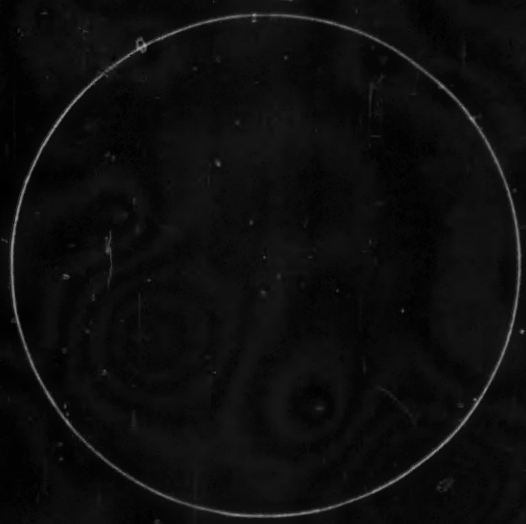
PHOTOMICROGRAPHS SHOW THE DIFFERENCE

Ordinary



MICROFINED



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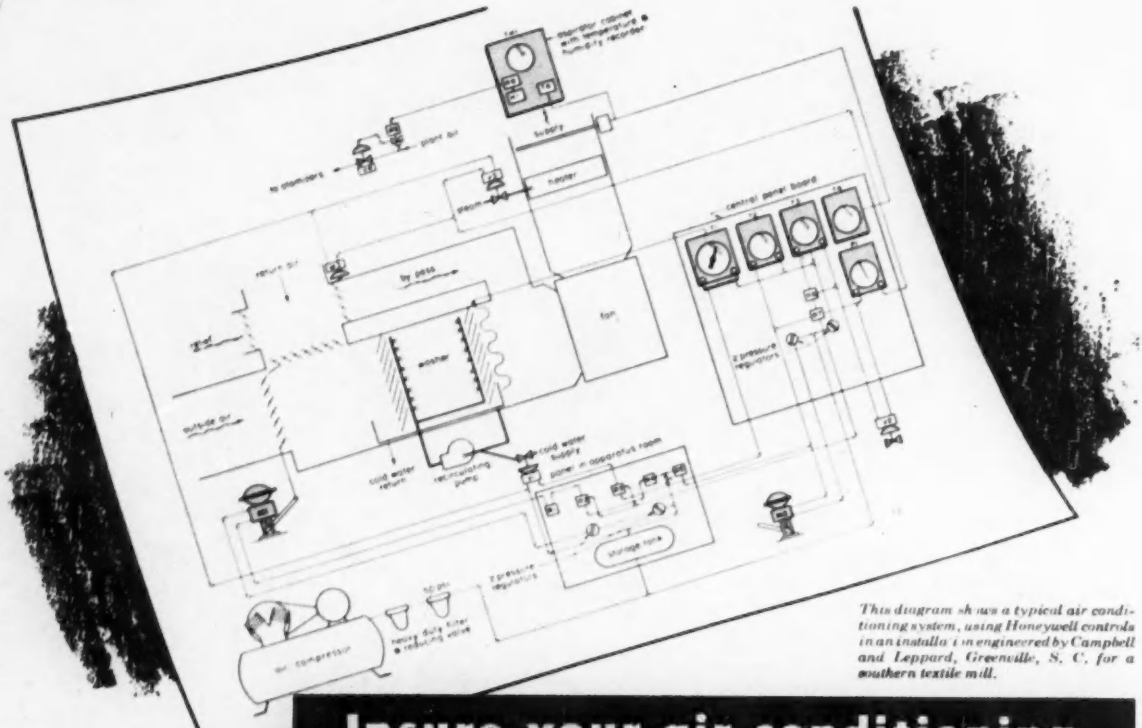

This diagram shows a typical air conditioning system, using Honeywell controls in an installation engineered by Campbell and Leppard, Greenville, S. C. for a southern textile mill.

Insure your air conditioning investment . . . with a Honeywell Control System

IT PAYS to be as particular about your mill's air conditioning controls as you are about process instrumentation. For the precision with which air temperature and humidity values are maintained determines how well you can capitalize on the inherent benefits of modern plant air conditioning. A well-designed system *must* include the best in control . . . to give you high uniformity of strength, pliability and related characteristics of yarn . . . stability of weather-sensitive wood and leather parts in shuttles, pickers and other machines . . . constancy of size formulas . . . production-boosting comfort for employees.

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News about

B. F. Goodrich Chemical *raw materials*

new crease-resistant finishes give superior strength characteristics

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Hycar latices offer many other benefits to textile manufacturers and finishers. For information that may help you upgrade a product or sharpen its sales appeal, please write Dept. CQ-11, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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Du Pont's top-performance scouring agent

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YES, NO MATTER HOW HARD THE JOB, "DUPONOL" RA proves time after time that it works quickly and efficiently. For complete information on "DUPONOL" RA, just write to: E. I. du Pont de Nemours & Co. (Inc.), Dyes and Chemicals Division, Wilmington 98, Delaware.

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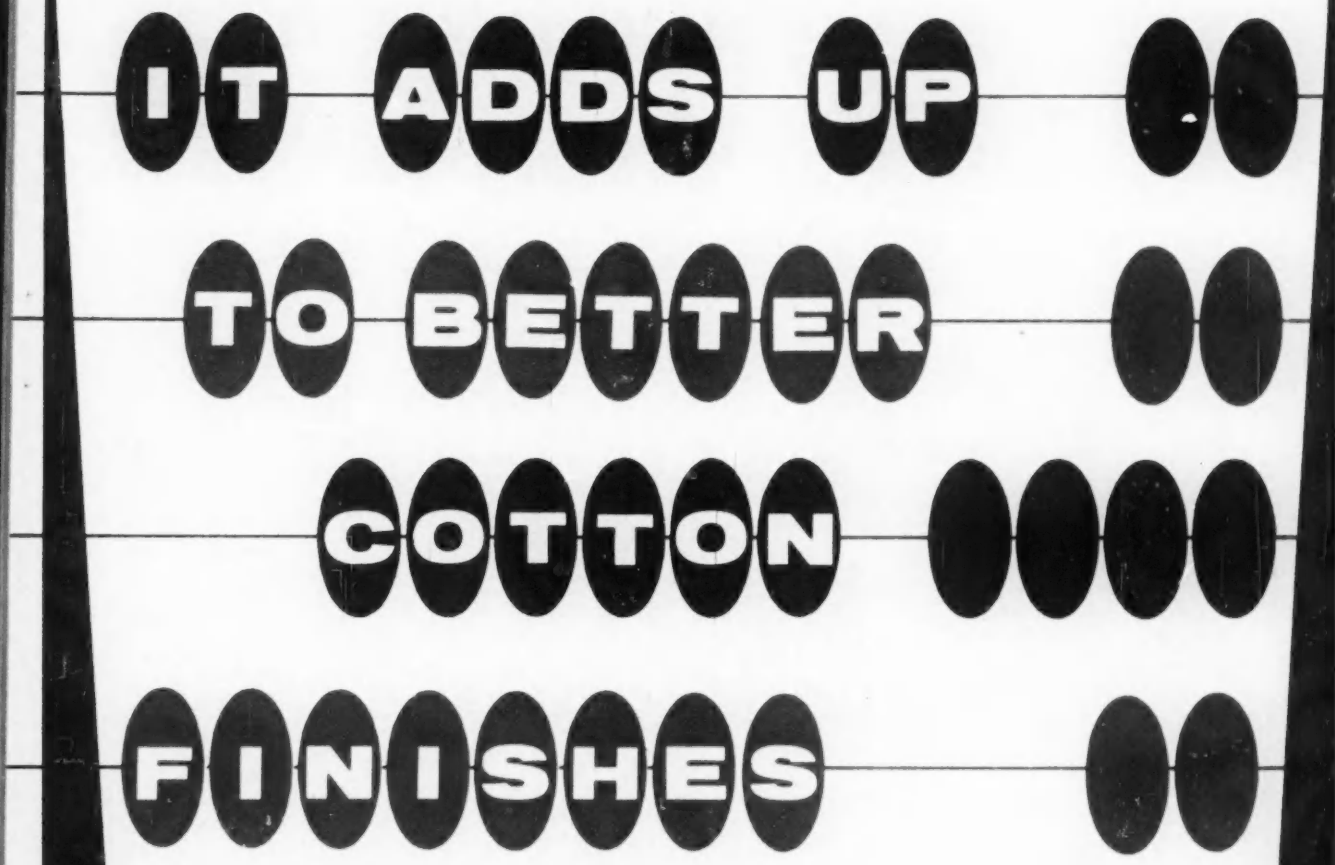

MOLLISAN AS

- \+ COMPLETE STABILITY TO YELLOWING AND RANCIDITY
- \+ EFFICIENT LUBRICATING ACTION
- \+ EXCELLENT ANTI-STATIC EFFECT
- \+ IMPARTS FULL BODY
- \+ HIGHLY COMPATIBLE IN MIXES
- \+ STABLE TO ACIDS, DILUTE ALKALIS
- \+ NON-FOAMING
- \+ ODOR-FREE
- \+ READILY SCOURED FROM GOODS
- \+ PLASTICIZER FOR NATURAL AND SYNTHETIC GUMS

All the plus values in finishing all types of cotton yarn and cloth with new MOLLISAN AS are far too numerous to list here. However, in addition to those points listed, consider these great advantages: it resists yellowing and rancidity even at highly elevated temperatures; improves the hand and appearance of starch or resin finished fabrics; is free from tackiness; enhances sewability, abrasion resistance, tear strength and cutting ease; is effective as a calendering assistant on chintz; acts as a softener in package dyeing and increases napping efficiency.

MOLLISAN AS will mean better quality, lower costs in your cotton finishes. Ask for complete information and samples.

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RHONITE R-1 treated fabrics can be calender-finished for a wide range of effects—from friction to deep embossed, from plain to moiré.

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May God's grace and truth, brought to earth

by His Son on that first joyful Christmas Day,

cover all the world at this sacred season and beyond,

and give peace to all men of good will.

AMERICAN DYESTUFF REPORTER

Keep Standards High With Standard Finishes

by JOHN J. BLOETJES

Metropolitan N. Y. Sales Representative

The problem of whites on acetate, nylon, Dacron, Orlon, and all synthetic fibers are solved with the use of Standafin 77, a fully polymerized resin in emulsion form that requires no curing or after-treatment, no washing, and is readily applied by ordinary finishing procedures on conventional equipment. The problems of yellowing of whites and light shades are eliminated; the worry of odor is gone.

Standafin 77 imparts a soft, silky hand, is an exceptionally good non-slip and is compatible with starches, weighters and dullers. The cost of finishing with Standafin 77 is low, as you use small percentages of this resin. In most formulas, 2 to 5% of Standafin 77 has been found to do an exceptional job.

In finishing of Nylon and Dacron for men's shirtings Standafin 77 imparts a full soft hand that gives wonderful quality to these fabrics. This product also has very good anti-static properties. Finishers of Acetate satins that require a high lustre and good non-slip qualities for use in underwear, etc. find that Standafin 77 gives these qualities, as well as the assurance that the product does not irritate the skin or cause dermatitis.

Standafin 77 is easy to use as it goes into solution very readily and does not foam. It is dissolved in approximately an equal amount of water at 120° – 140°F. and the solution added to the bulk of the finishing liquor. The goods are padded on a thoroughly cleaned quetsch at 120°F. Curing is unnecessary but drying must be complete with no tackiness resulting from insufficient drying. If padding and drying in two separate operations is necessary, it is well to batch up loosely or run into a box and avoid partial or uneven drying.

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In dyeing, Pyrotex 121 promotes levelness, penetration and clear shades; chafing and rub marks are prevented and the goods are left with a soft, pleasing hand.

We recommend you try Pyrotex 121 – it's truly the "Aristocrat of Detergents."

Standafin T. Conc. Gives Swish to Taffeta

When a taffeta finish requiring swish, non-slip and extraordinary character is needed, send for STANDAFIN T CONC. It imparts a rustling sound, firm hand and fullness that is so desirable in this type of cloth.

STANDAFIN T CONC. is a non-curing resin that requires no after-treatment or washing. It can be used with weighters and water repellent compounds.

STANDAFIN T CONC. is easy to use on pad, quetsch, or Palmer tenter unit. It will not mark off and is not affected by atmospheric conditions.

Phone us and switch to STANDAFIN T CONC.

Standafin 92 Uses

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Devoted to Textile Chemistry
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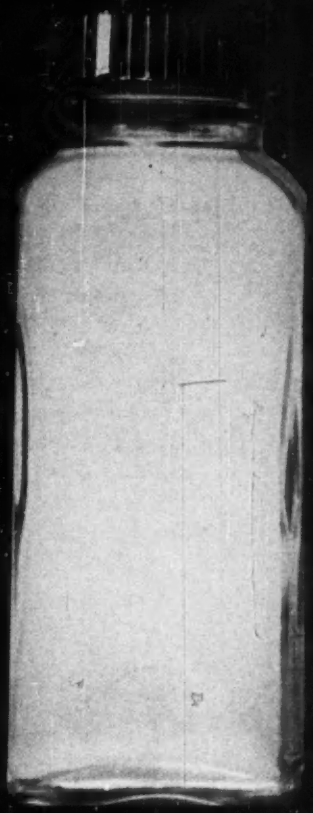

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and See for yourself

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IS THE LARGEST SELLING LIQUID DETERGENT* IN THE TEXTILE INDUSTRY

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on an equivalent active-ingredient basis Nacconol SL is a better money-value than most dry products. Your detergent-materials cost is less because you get more cleaning power per dollar.

and

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For complete technical data, send for Bulletin 326.

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AMERICAN
DYESTUFF REPORTER

VOLUME 44 DECEMBER 19, 1955 NUMBER 26

THE SOLVENT SCOURING OF GREASE WOOL. I—REVIEW

DANIEL P NORMAN and W W A JOHNSON

New England Spectrochemical Laboratories
Ipswich, Massachusetts

The principles and practice of the solvent scouring of wool are reviewed in the light of current knowledge of solvent extraction as an engineering process. The general terms and operations common to all solvent extraction systems are defined and illustrated, and then the problems which are peculiar to wool scouring are described in detail. A great deal of the information about wool grease which is needed to design a rational solvent-scouring system is still not available. This is particularly true of the choice of solvent.

INTRODUCTION

THE solvent scouring of wool has been under continuous consideration in the textile industry since 1880 *(1)* and has repeatedly been brought to the level of commercial operation. With the possible exception of the Arlington Mills' operations in Lawrence, Mass, which have now been shut down, all the attempts failed to achieve long-term economic success. In the meantime, however, the solvent extraction of products other than wool has become a common commercial operation, with an established economic and technical position. Curiously enough, little systematic attempt has been made to apply the vast amount of information accumulated in these other fields to the problems of textile scouring. While it is undeniably true that the mechanical problem of handling wool is substantially different than that encountered in handling oil seeds, canaigre roots, or minerals, the fundamentals of the solvent extraction (or leaching) of all these products are the same. We review herewith the solvent scouring of wool in the light of modern solvent extraction operations.

PRINCIPLES & GENERAL PRACTICE OF SOLVENT EXTRACTION

DEFINITION OF SOLVENT EXTRACTION———Solvent extraction is a common unit operation of chemical engineering employed for separating materials of different solubilities. It may be defined as the process of removing, by the application of a solvent, those constituents of a mixture which are soluble in the selected solvent. If the mixture is heterogeneous and the main component is a solid, the extraction process may be called leaching. The solvent may be any suitable liquid, including water, an organic liquid, a salt solution, or a mixture of these liquids. Conventional aqueous wool scouring will be recognized as a solvent-extraction process in which aqueous alkali is used as a solvent (and as a suspending agent).

PRINCIPLES OF SOLVENT EXTRACTION———Basically an extraction process is composed of four operations:

a) Preparing the material (mixtures) for extraction.
b) Bringing the material into close contact with the solvent.
c) Separating the solvent extract or miscella from the extracted material.
d) Separating the solvent from both the extract and the extracted material.

Figure 1 is a generalized flow chart illustrating all solvent extraction processes. It is notable that the success of all such processes is markedly dependent upon the efficiency with which the raw material is prepared for extraction, and that perhaps a third of all patents in this field, and nearly as much of the capital investment in commercial processes, are tied up in this phase of the operations. This is equally true in the case of wool, and, as we shall see later, improper opening or preparing of grease wool is sufficient to double the cost of a solvent-scouring process.

The theory and practice of gas-liquid and liquid-liquid extractions are very highly developed, and if the chemical and physical properties of the mixture to be extracted are known, an efficient and economical extraction plant can be constructed with little preliminary experimentation. In the case of solid-liquid extraction, or leaching, it is so difficult to predict the efficiency with which the soluble components can be brought into intimate contact with the solvent, that the majority of the plants in operation today have been designed primarily on an empirical basis, with very little regard for theoretical considerations.

Efficient solvent extraction requires that the difference in concentration level between the soluble components in the solids being extracted and the materials already dissolved in the solvent shall be as great as possible. In order to effect the greatest difference, continuously, it must be possible to change the solvent at each solid-liquid interface thoroughly and continuously. Usually this is accomplished by continuously moving the solvent, the solids, or both. Because of the effects of surface tension, however, the layer of solvent immediately next to the solid—the very layer which it is most important to change rapidly—is only moderately disturbed by anything other than the most violent agitation. This is the reason that the efficiency of an extraction usually increases rapidly with an increase in the velocity of agitation of the solvent-solids mixture. Rapid agitation of large masses of solids demands a great deal of power and tends to increase the rate of loss of volatile solvents. We find, therefore, that the principal difference between all commercial solvent-extraction installations lies in the means used to effect the movement of the solids relative to the solvent. In the case of wool, however, the necessity of avoiding felting and mechanical fiber tion efficiency that usually the wool is either kept stationary or else is moved very slowly by means of continuous belts

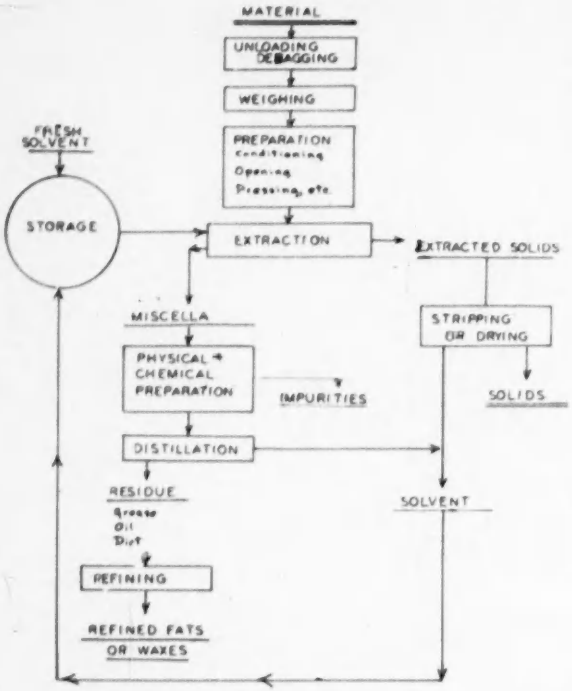

Figure 1
Solvent extraction—general flow chart

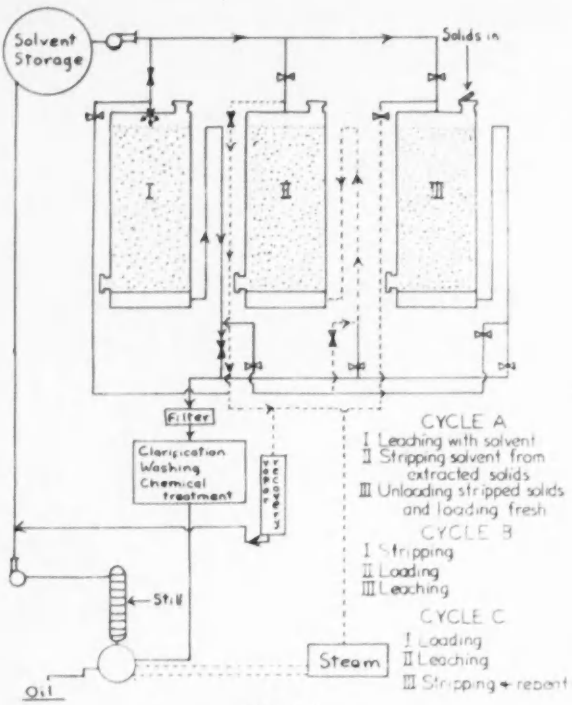

Figure 2
3-Unit percolator extractor

or conveyors, with a minimum of agitation.

In most solvent-extraction processes it is necessary to leach one component from within a solid matrix. In such circumstances, it can be proven that the time-rate of any extraction varies inversely as the square of the thickness of the particles being extracted. It is equally important that the particles be uniform, since the presence of even a moderate percentage of coarser particles will result in a gross lack of uniformity in the rate at which the extraction can be completed. It is therefore customary to improve the efficiency of any extraction process by cutting, grinding or otherwise subdividing the material to be extracted as finely as possible. In the case of fibers, of course, such subdivision is impossible, but fortunately is unnecessary because the materials to be extracted lie substantially wholly on the surface of the fibers. It is very important, however, to open the fibers effectively, so that matted clumps and tufts are broken up to such an extent that the solvent can freely penetrate and bathe all fibers. This problem will be discussed in detail below, but it is worth noting here that an unopened wool tag, initially containing some 20% grease, will emerge from twelve fresh solvent changes still containing 12% grease, where the same tag, properly opened, will be completely degreased in only five solvent changes.

CHOICE OF SOLVENT——The rate at which any soluble component can be extracted from a solid varies with the solvent used and with the nature and solubility of the other components present, as well as with the physical form of the material. In the case of oil seeds, for example, the oil usually dissolves more rapidly than the pigments or phosphatides. In the case of wool, the rate of extraction of dirt, suint, and grease varies markedly with the solvent used. By proper choice of solvent, it is frequently possible to remove selectively one component, while leaving most of the other components behind. In the case of wool, it appears to be desirable to remove all the dirt and suint, but not necessarily all the grease, since some grease is essential for the subsequent textile operations.

The choice of solvent to be used in any given extraction is governed by the efficiency of the solvent, by its cost, by the purification required to recover the extracted components and the solvent, and by the hazards involved in its use. Generally speaking, a highly selective and efficient extraction solvent is preferable to a less efficient but correspondingly cheaper solvent because the economic advantage of the initially cheaper solvent is more than offset by the greater volume of solvent which must be handled. On the other hand, a cheap but flammable solvent has generally been preferred to a more expensive but nonflammable one of equal efficiency. For the same reason, if two solvents of approximately equal extraction efficiencies are available, the lower boiling of the two will be selected because of the saving in fuel cost involved in the subsequent recovery of the solvent. Thus we find that in both the oil-seed and the wool-degreasing industries, dangerously flammable hydrocarbons, such as hexane, are preferred to nonflammable chlorinated hydrocarbons, and that where nonflammable solvents are used, the lower boiling but more toxic trichlorethylene is preferred to the less toxic tetrachlorethylene.

All solvents other than water are toxic to a varying extent and most organic solvents present a serious fire and explosion hazard. However, even the most dangerous solvents can be handled safely in large volumes provided adequate safety precautions are rigorously enforced, and therefore the hazards involved have not deterred management from their use. Again, we can cite the Arlington Mills' operations as a case in point, where highly flammable gasoline components were used for many decades with no major accident.

In general, the solubility of any material in a given solvent increases with increasing temperatures, and we find that a large proportion of oil-leaching plants use hot solvents. Since the solvent is usually removed from the miscella by distillation, the only extra cost involved in the use of heated solvents is that of

the heat lost in bringing the material to be extracted to the temperature of the solvent, and the heat losses in the equipment. The upper temperature limits are set by the boiling point of the solvent used (although vapor degreasing may be carried out at still higher temperatures) or by the thermal instability of some component of the system under extraction. In cases where a very complex mixture of compounds of variable solubilities is being extracted, it is frequently possible to effect a clean separation of components by carrying out the extraction at a rigorously controlled temperature which selectively favors the extraction of one component, and in some cases, a refrigerated rather than a heated solvent may be used for this purpose.

The solubility of individual materials in specific solvents varies greatly. The solubility of crystalline compounds is, as a rule, limited and usually increases with rising temperatures. This is not true of oils, fats, and colloids, where the solvent and solute are miscible with each other in all proportions. Lyophilic colloids are capable of absorbing almost unlimited quantities of solvents, and the products vary from thin, watery solutions to extremely viscous solutions in which the solution can scarcely be distinguish from the solid which was dissolved. In general commercial practice, it is usual to work with solutions of low viscosity, which can be readily pumped.

It is unnecessary to discuss the theories of solubility here, (see *(2, 3)* for detailed references), but it is important to note that, in organic compounds, the general solubility rule is that like dissolves like. Broadly speaking, all organic compounds can be classified in two groups, polar and nonpolar. Polar compounds are those whose internal electrical charges are unbalanced, while nonpolar compounds have balanced internal electrical forces. These characteristics correspond somewhat to assymmetrical and symmetrical molecular structures. Water, alcohols, acids, sterols are all polar compounds; hexane, most hydrocarbons, and many waxes are essentially nonpolar. (It must be borne in mind that these two classes grade imperceptibly into each other, so that there are many different degrees of polarity). Polar compounds will dissolve in like solvents; ie, polar solvents; nonpolar compounds will dissolve in nonpolar solvents. Ordinary fats, oils, and petroleum greases are substantially nonpolar and do not dissolve well in nonpolar solvents, such as carbon tetrachloride. Because wool grease has a similar name to the petroleum greases and is partly soluble in nonpolar compounds, it has been a common assumption that nonpolar solvents are suitable for the solvent scouring of grease wool. As we shall see later, such is very far from being the case. A very substantial proportion, perhaps half, of wool "grease" is composed of polar, nongrease components, which have a very limited solubility in nonpolar solvents. For this reason, most, if not all, past solvent-scouring systems have had to follow the solvent scour with a water (polar-liquid) scouring to remove undesired polar components from the wool, before the wool could be processed.

Few other generalizations can be made about the selection of solvents for leaching, because the choice obviously must be varied to suit the material being extracted. A very large proportion of all leaching plants are designed to recover oils of various types (soybean, peanut, flaxseed, cotton seed) or to free a material of its fat or wax constituents (wool, cotton waste, lubricating oils, sugar-cane press cake); therefore a correspondingly large proportion of all the solvents used are oil and fat solvents (hexane, benzene, acetone, isopropanol, trichlorethylene, petroleum ether). It must be remembered, however, that water is a solvent just as much as any organic liquid, and that sugar-cane extraction, beet-sugar extraction, aquenous wool scouring and the acid leaching of minerals are valid examples of solvent extraction.

A particular solvent is frequently selected for a given leaching operation because of some special property it possesses, which makes the purification of the solvent or the recovery of the extracted material particularly simple. Zein (the protein from which Vicara is made), for example, is soluble in concentrated ethyl alcohol but is insoluble in dilute alcohol. It is therefore extracted from corn with 85% ethyl alcohol, and is recovered in a relatively pure state by simply diluting the alcohol miscella with water, thus forcing the zein out of solution. In cases where several chemically different components must be removed from a solid, such as oil and pigments, or grease and suint, two or more selective solvents may be used, rather than a single all-purpose solvent, and the multiple solvents may be used simultaneously or in series. Hexane-water, methanol-benzene, methanol-ethanol, petroleum ether-acetone, and similar mixtures have been used in commercial scale extractions and almost every possible permutation of solvents has been used in serial extractions. In every case such multiple-solvent systems have been adopted because the effeciency of the resulting extraction has more than overbalanced the added cost of the separation and recovery of more than one solvent. For this reason azeotropes have been used where possible because the solvent mixture can then be recovered in a single distillation. Unfortunately, the presence of extracted components in the solvent may upset the stability of the azeotrope and the economic use of such azeotropic solvents is more restricted than is to be expected at first thought.

By way of summary, we tabulate the principal factors that govern the selection of a solvent, roughly in their order of importance:

a) Its effectiveness and selectivity in removing or failing to remove the desired component.
b) The ease with which the various components can be removed from the solvent and subsequently purified.
c) The industrial hazard (flash point, toxicity).
d) The cost of repurifying used solevnt.
e) The cost of removing all the solvent trapped or adsorbed in the extracted solids.
f) Its volatility (solvent loss versus distillation cost).
g) Its cost.
h) Its corrosive effect on equipment.

THE MEANS OF BRINGING THE SOLIDS AND SOLVENT INTO INTIMATE CONTACT———No two leaching installations are the same in detail, because each succeeding one is improved in the light of the experience obtained in the preceding ones. Many systems that are in some way preferable to the commercial systems have been described in the literature, but have been omitted from consideration here because they cannot be bought commercially. The principal feature differentiating all the extractors from each other is the means used to move the solids and the solvent past each other.

a) *Percolator Extractors.* The oldest and most widely practiced leaching system is simple percolation of the type used in making coffee. The material to be extracted is held stationary in a basket, bag, or tank, and the solvent is pumped through it either upwards or downwards. In either case, the solvent tends to flow through channels in the solids or creep between the solids and walls of the container, resulting in incomplete extraction. Despite these drawbacks, percolation systems are popular because of their inherent simplicity and low cost.

Figure 2 illustrates a three-unit percolator extraction system. While one unit is full of solids and is being extracted with solvent, the second unit has been drained and the residual entrained solvent is being stripped from the solids by heat (usually steam or hot nitrogen from stack gases), while the third percolator is being emptied and refilled with fresh solids. On the next cycle, the initial tank is drained and the extracted

solids are stripped of retained solvent, the tank which was previously used for stripping is now emptied and refilled, while the tank which was last filled with fresh solids is now leached.

In many cases the percolator which is being leached is replaced by a series of percolators through which the solvent flows in series, and the one which is nearest the fresh solvent is taken off-stream to be stripped and refilled, while the freshly filled percolator goes on-stream and is washed with solvent which has been through the other percolators. This type of "battery" may have anywhere from three to fifteen percolators in series. In the textile field, the Arlington Mills' solvent-scouring operations represented a typical percolation system of this type. The wool was packed into large vertical kiers of 2,500 pounds grease-wool capacity. The kier was sealed, the air evacuated, and gasoline (naphtha) was introduced. The extraction was carried out in three steps, the first time with solvent, which had been used twice, the second time with solvent, which had been used once, and the third time with fresh solvent. In each case, the solvent remained quiescently in contact with the wool until it no longer dissolved any grease, when it was emptied through a valve in the bottom of the kier and was replaced by the next batch of solvent. The naphtha left in the wool was removed by circulating hot gas through the kier until all the solvent was driven off.

b) *Counter-current, Multiple Contact Extractors.* Percolator extractors are primarily adapted to handling single batches of product. Multiple extraction and a true continuous counter-current extraction can be approximated by linking together a whole series of percolators, but the capital investment and inconvenience of operation of such systems has led to the adoption of more compact and complicated systems.

One of the simplest improvements over the percolator-type extractor makes use of the familiar principle of the dilution law, which can be expressed as

$$X_n = X_o \left(\frac{U}{U + V} \right)^n$$

where

X_o is the concentration of the extractable material

X_n is the concentration of the extractable material after n extractions

U is the volume of the solvent remaining entrained in the solids

V is the volume of solvent used in each extraction, and

n is the number of extraction cycles.

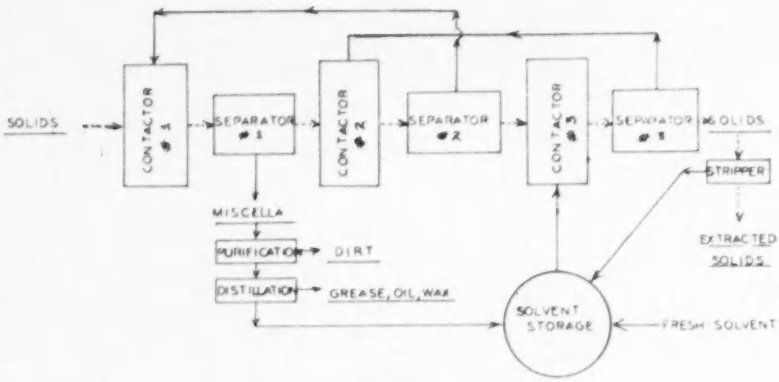

Figure 3

3-Stage counter-current multiple contact extractor

It follows from this expression that any given volume of solvent is most efficiently used in an extraction when it is applied in several small aliquots, and that it is best to separate the maximum amount of solvent from the solids before additional solvent is used. As applied to wool scouring, it follows that an extraction system in which the solvent is squeezed, wrung, centrifuged or pressed out of the wool between applications of solvent will be a much more effective extraction system (at least in so far as solvent use in concerned) than a system which merely uses solvent continuously without effectively freeing the wool of entrapped solvent and miscella. This point will be raised again below, in connection with the discussion of specific wool scouring systems.

Figure 3 illustrates a three-stage, counter-current multiple-contact extractor. Fixed charges of solvent and solid are brought in contact in a tank, kier, or mixer, for a given period of time (usually about 10 minutes) and are then led to an efficient separator, which may be a centrifuge, pressure rolls, screw press, or hydraulic press. The process is repeated as many more times as is necessary to attain the desired degree of extraction. Where the extract is particularly valuable and sensitive to oxidation, as in the case of certain essential oils, fresh solvent will be used in each extraction cycle. In general, however, the fresh solvent is used on the final, nearly spent, solids, and the initial miscella is used to extract partially extracted solids, while the final, nearly saturated miscella is used for the initial extraction of fresh solids.

c) *Continuous Extraction.* It is an obvious step to replace a series of disconnected percolator extractions of the type illustrated in Figure 2 by a connected series of solvent tanks or chambers through which the solids are moved continuously by a moving belt or chain. Such a system involves an unnecessarily large volume of solvent, and in an attempt to minimize the amount of solvent required, the extractor is not filled, but the solvent is sprayed onto the moving solids. Figure 4 illustrates such a moving-belt extractor. The Smith-Drum extractor is an example of this type of equipment applied to the solvent scouring of wool *(4)*.

Similarly, a continuous form of the counter-current, multiple-contact extractor is used commercially in the German oil-seed industry, with continuous centrifuges as the separators (Fauth System). No equivalent system is in use today in the textile industry, but such a system was described and patended in 1908 by Shuman *(5)*, and a modification was patented in 1949 by Hoffman *(6)*. The Shuman system is illustrated in Figure 5.

All solvent-extraction systems suffer from difficulties with the conveying mechanisms. Screw-type conveyors habitually leak at the shaft stuffing boxes, while continuous-belt conveyors suffer from degradation and corrosion of the belt materials. A wide number of ingenious devices has been invented to overcome these difficulties and are in common use in plants solvent-extracting many millions of pounds of materials yearly. So far as textile applications are concerned, the only continuous (non-aqueous) solvent-extraction equipment now being offered commercially are the Smith-Drum and Hoffman systems. In the Smith-Drum apparatus the wool is moved intermittently, but effectively in a continuous manner, between two layers of stainless-steel rods, by a cam-operated

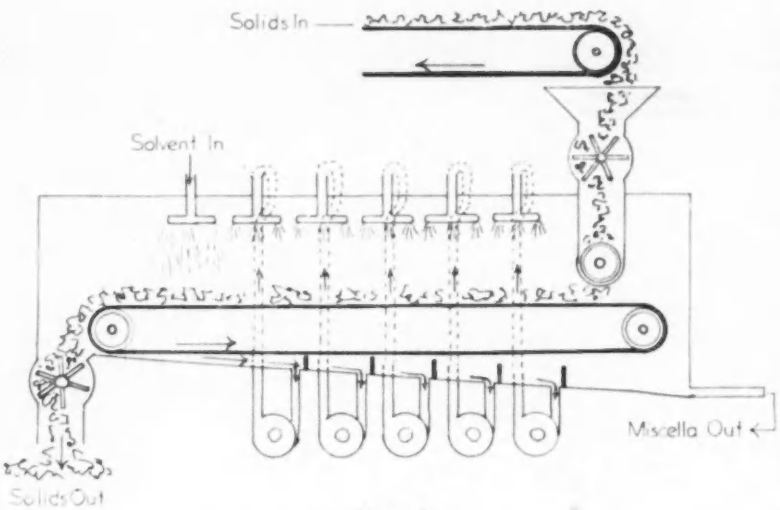

Figure 4
Moving-belt spray extractor

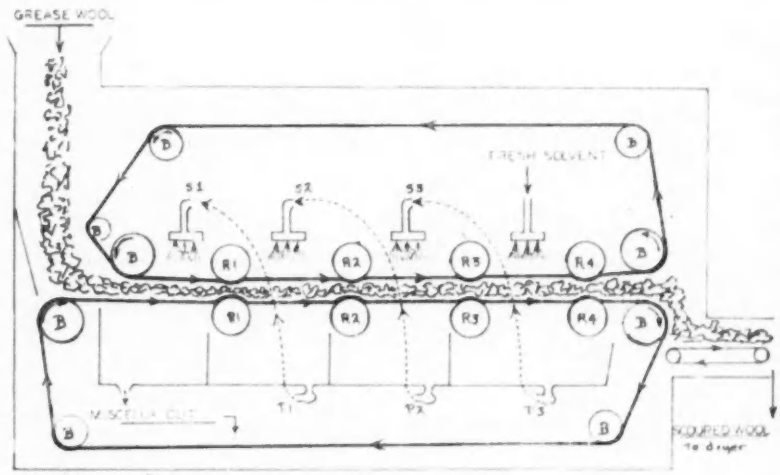

Figure 5
Moving-belt and pressure-roll solvent extractor
(After Shuman, U.S. Pat. 800,440 (1938))

system of steel pins. In the Hoffman apparatus the wool is advanced continuously between closely spaced pairs of rollers. There is no textile solvent-scouring equipment offered for sale today in which the wool is moved on endless belts, but such equipment is in regular commercial use in the oil-seed industry. The endless belts may be made of articulated stainless steel plates, stainless steel fabric, polyethylene and other synthetic-polymer plates, and fabrics.

THE SEPARATION OF SOLIDS AND MISCELLA———Regardless of the type of extractor used, batch or continuous, it is necessary to separate the extracted solids from the miscella. This may be accomplished by simply draining the solvent on a screen, which is essentially what the Arlington Mills and Smith-Drum processes do; the solids may be centrifuged, which is the practice in the Fauth oil-seed-extraction system, and is alleged to be used in the latest version of the Hoffman process; hydraulic press rolls have been suggested, as in the Shuman process, but have not apparently found commercial acceptance because, for most particulate solids, continuous centrifuges offer a more satisfactory and economical apparatus. This is particularly true because the heaviest solvent loss in extraction systems, next to the solvent trapped in the solids, is due to evaporation of volatile solvents during the separation, and continuous centrifuges can be totally enclosed more effectively than any other equipment.

No matter how efficient pressure or gravitational (drainage or centrifugal) separations may be, some solvent always remains entrained in the solids. With some materials and processes, this is of little consequence, but in most cases this factor represents the heaviest economic loss in the entire system, and may make the extracted solids unfit for their intended use. Where this is the case, the residual solvent is usually removed from the solids by heat or heat plus vacuum, and the stripped solvent vapors are recovered by condensation, solution in oil, or adsorption on activated carbon.

The total solvent loss from all causes in a commercial extraction system is expected to be less than 1%, and in a good system can be held to less than 0.5% by careful operation.

RECOVERY OF EXTRACTED MATERIALS———In most leaching systems the extractable components removed from the solids are of greater economic value than the residual solids, but even when these extracted materials are of minor value when compared to the purified solids, as they are in wool scouring, they are still of sufficient value to justify the installation of very elaborate equipment to recover them. The recovery systems are as varied as the materials being recovered and the solvent with which they are extracted, but a common feature of all systems is that the products are purified as far as possible (by chemical or physical processes), before the solvent is removed, and that extreme precautions are taken to avoid their thermal degradation during processing.

Ideally, all the components removed are recovered as by-products, and this ideal is closely approximated in many industries, particularly the oil-seed and fish-meal industries. In other fields, such as wool scouring, only a portion of the extracted components are recovered as by-products, and the remainder must be treated in some fashion to prevent them from becoming pollution threats. Where this is the case, again the treatments must be varied to suit the materials being processed. This question will be further discussed below in connection with wool-scouring wastes.

THE RECOVERY OF THE SOLVENT———The recovery and reuse of the solvent is an essential element of all commercial leaching systems in which the solvent is not water. Again, the details of the solvent-recovery system vary with the solvent used and the materials ex-

tracted. Broadly speaking, most solvents are refreshed and recovered by distillation or vacuum distillation; an appreciable number are purified by counter-current extraction with immiscible solvents or by adsorption; a few are purified by freezing and filtration, or by chemical treatment. To date most systems for purifying wool scouring solvents have depended upon simple filtration followed by distillation.

THE SOLVENT SCOURING OF WOOL

INTRODUCTION AND DEFINITION OF TERMS USED——In the previous Section we have discussed the general considerations which are common to all solvent-extraction processes, although we have attempted to illustrate them as far as possible with examples from the wool-scouring field. As we noted repeatedly, the choice of solvent, process, and equipment is markedly governed by the material to be extracted, and in the discussion which follows we will attempt to consider these items in detail as they apply explicitly to the wool-scouring problem. Before doing so, it is necessary to review just what grease wool is and what the solvent scouring of wool is expected to accomplish. As we have already noted, the composition of the grease markedly affects the choice of the solvent to be used.

Raw grease wools contain a variety of adherent materials, which must be more or less completely removed before the wool can be processed on conventional textile machinery. The range in composition of fine wools is given in Tables I and II.

Most wool-scouring processes are designed to remove more or less completely the yolk (grease and suint) and the dirt. Both of these terms cover a multitude of materials and are seldom defined precisely.

The term *yolk* is usually applied to all the extraneous material adhering to the wool fibers which is produced by the sheep itself, and includes suint and grease. *Suint* is customarily defined as the water-soluble portion of the yolk and is mainly dried perspiration, although its composition is substantially different than that of the sweat of other animals.

Wool Grease is the term usually restricted to the crude, contaminated fatty products obtained from raw wool; *wool wax* is a term which is reserved for a purified grease; while *lanolin* is a low-acid-value light-colored wax *(8, 9)*. Neither suint nor grease are simple compounds, and their amount and composition vary from point to point in a single fleece, from sheep to sheep, from breed to breed, with the climate and feed, and, finally, with the processes by which they are separated from the wool fibers.

TABLE I
APPROXIMATE COMPOSITION OF RAW WOOL (7)

Component	*(%)*
Wool fibers	20-50
Moisture	8-12
Yolk (grease & suint)	20-50
Sand and dirt	5-40
Vegetable matter	0.5-2

TABLE II
IMPURITIES IN FINE WOOLS (11, p 265)

Impurity	*(%)*
Moisture	8.6
Grease (petroleum ether extract)	17.4
Total ash	23.8
Suint (water extract)	14.0
Potassium in suint, as K	3.0
Nitrogen in suint, as N	0.5

TABLE III
APPROXIMATE CONSTITUTION OF AUSTRALIAN WOOL GREASE (13)

Component	*(%)*
Free acids	3.45
Free alcohols	0.03
Diesters	31.7
Mono-esters	64.8

Suint is the component of yolk which is alleged to be responsible for the "stickiness" of grease wool. Because it is primarily, by definition, a water-soluble complex, it is not particularly soluble in nonpolar solvents, such as gasoline or hexane. These nonpolar solvents will remove all the grease from wool leaving behind most of the suint, thus leaving the extracted wool too "sticky" to be carded conventionally. It is therefore customary to remove the suint by a separate aqueous scour following the extraction with nonpolar solvents (Arlington Mills; Smith-Drum), and in the past, apparently, at least one mill (Erben and Harding, Philadelphia, Pa) used an aqueous scour prior to the solvent scour. As we go from nonpolar solvents, such as hexane, to increasingly polar solvents, such as the chlorinated solvents, and finally the alcohols, more and more suint is removed by the solvent, and there is less and less reason to use an aqueous treatment for the removal of suint. Correspondingly, however, the grease extracted by the more polar solvents is more and more contaminated with suint salts and is increasingly difficult to purify to lanolin. This is an economically and technically important consideration and must be kept in mind in the following discussion.

Suint is essentially dried sweat and is composed principally of a mixture of the potassium salts of fatty acids and of inorganic acids, together with small quantities of sulfate, phosphate, and proteins. There are approximately 2.5 kg of suint per sheep, (or 9 lb of yolk ash per 100 lb of grease wool), so that the 500 million sheep in the world are capable of yielding 1.25 million tons of potassium salts. The suint salts are highly water soluble and their water solutions have been commercially concentrated to a syrup, and this syrup ashed, to yield valuable potassium salts composed of some 60% potassium carbonate. The process is, however, expensive and can be carried out commercially only where large-scale scouring is practiced and potash is expensive, as in Germany *(10)*.

Surprisingly little information is available on the detailed composition of suint, partly because it was of little value except in the case of its potassium content; partly because it was usually heavily contaminated with other soaps during conventional scouring operations; and partly because it is an excellent emulsifier and in aqueous solutions is always heavily contaminated with wool grease. It is known *(11)* that in fine wools the suint (water extractables) ranges from 23% to 6.3% (grease wool basis) with an average of 14%; the potassium content of the suint (as potassium, *not* K_2O, wool grease basis) ranges from 5.4% to 0.9%, with an average of 3%; while the nitrogen in the suint (grease wool basis) averaged 0.5%, which would correspond to 3.2% protein. These same wools ran from 42% to 6.1% grease, with an average grease content of 17.4%. These average figures (based on 93 fine wools) are summarized in Table II.

Little modern data is available on the composition of the fatty acids of suint. Older references suggest that they are composed of the fatty acids from valeric to palmitic but recent data on the composition of wool grease acids *(12)* has shown them to consist of more complex isomeric acids, so that it is not unreasonable to conclude that the suint acids also will be composed in large measure of these isomeric acids. Salts of fatty acids are, of course, classical soaps, and it is interesting to note that there is no technical information at all available on the potassium salts of the isomeric acids, and practically no information on the potassium salts of the saturated fatty acids.

Wool grease, though apparently of more complex composition than suint, has been more thoroughly studied, because of its potential and actual industrial value. The current state of knowledge in this field has been well discussed by Gillespie *(9)*, but the discussion is somewhat altered by Bertram's more recent computations. These discussions are summarized briefly in Table III.

The alcohols which compose the esters fall into three classes: sterols, triterpenes, and normal aliphatic alcohols, with cholesterol comprising up to 40% of the total. The acids which compose the balance of the esters are almost wholly members of the saturated fatty acid series, but are predominantly members of the rare iso-

and anti-iso-branched-chain series *(12)* rather than of the usual straight-chain series. No information is available as to the composition of the free fatty acids as contrasted with the ester acids, but it is usual to assume that they are similar.

We must stress again the fact that all the terms commonly used in discussing wool grease components have no absolute meaning independent of the particular process by which they have been derived. Solvent scouring is usually intended to remove only wool grease from raw wool, the suint salts being removed by a water wash before or after the solvent scouring. Bearing in mind the complexity of both grease and suint, it is clear that the choice of solvent and the method and degree of its application will alter significantly the amount and nature of the material removed during solvent scouring. Despite the many studies which have been made on solvent-scouring processes since 1881 *(1, 14)* surprisingly little concrete data are available on the variation in the composition of the materials removed by various solvents and processes. It is particularly noteable that there is current an impression that suint salts are not removed by solvents *(9,* p 24), whereas in 1914 it was well known that common solvents, such as naphtha and acetone, did remove a substantial amount of potassium salts *(1,* Vol II, p 889).

We note, for example, that in a recent publication by the U S Department of Agriculture's Western Regional Research Laboratory *(15),* the statement is made that "grease content was determined by extraction with an organic solvent" without any reference to the solvent used and with the clear implication that the investigators concerned did not realize that a change in solvent would result in a change in their results. What is still worse, we fine that, in various survey articles, suint figures obtained by extracting grease wool with water before solvent extracting the wool are treated as equivalents of suint figures obtained by extracting wool with water after the grease has been solvent extracted. It is obvious that no valid conclusion can be drawn from such diverse data. An examination of the range in variation of the constants for commercial "refined wool grease" presented by Warth *(16,* p 77) will show that this is no academic hair splitting, but a vital fact that must be remembered constantly when considering the commercial production of wool grease.

The complete lack of accurate data on the solubilities of potassium salts of fatty acids and of the complex wool esters in different organic solvents makes it completely impossible to select a suitable solvent by any but empirical trial. Gillespie *(9,* p 29) has presented a table of the solubility of wool wax, its alcohols and its acids, in various solvents on a crude qualitative basis, but since he opens with the misstatement that wool wax is substantially insoluble in acetone (where acetone has been widely used in Europe as a solvent for the complete extraction of wool grease *(1)),* and his figures are admittedly rough and qualitative, we cannot safely use this data as other than the roughest of guides. We note that he reports that only carbon disulfide and trichlorethylene will completely dissolve 30% wool wax, while benzene, carbon tetrachloride, ether and naphtha will completely dissolve smaller amounts. No data are given as to the nature of the components which first come out of solution, or the temperature coefficients of solubility, which can be of major economic significance.

REQUIREMENTS OF A WOOL-SCOURING PROCESS——It seems fair to summarize the requirements of any grease wool scouring process in the following terms:

a) The wool produced must be undamaged and clean; it must be completely free of suint; it should retain approximately 0.5% of neutral grease; it should not dust badly in the cards; it should not need an aqueous treatment until after it is spun or woven; and it should, if possible, be processable on current machinery (although it is likely that only alkali-processed wool can be so processed).

b) The profit from by-product recovery operations should at least equal that obtained at present from the sale of wool grease recovered from the aqueous scouring process.

c) The BOD of all effluents from the process must be of the order of 0.15% of the grease wool, or approximately one-tenth of that encountered with the best present aqueous scouring system (if it is to meet the pollution requirements of states such as Pennsylvania).

With these requirements in mind, let us examine the solvent scouring systems which have been seriously proposed or practiced in the past.

EQUIPMENT——As we noted in the Section on "Principles & General Practice of Solvent Extraction," several types of solvent-extraction equipment have been used and proposed for the scouring of wool, ranging from the simplest type of tank or kier batch equipment to very elaborate continuous counter-current machinery. It is apparently true that any type of extraction equipment can be operated so as to remove grease from the wool to any desired degree if the proper solvent is used. In general, that has been the principle goal in the design of extraction equipment, and it has been attained. The major differences and difficulties in solvent-scouring equipment come in the treatment of the wool after the extraction, and it is fair to say, in terms of the prior discussion, that most wool-scouring equipment is satisfactory from the point of view of bringing the solvent and the wool together, but is only moderately satisfactory or is downright unsatisfactory in separating the solvent and the wool, and in recovering the wool and the materials extracted from the wool in a satisfactory condition. These failures in the wool-scouring process can only be discussed adequately in connection with the solvents proposed, and will therefore be taken up in the next Section. It is a curious fact that, to date, no one has proposed or offered for practical consideration a complete wool-scouring process (as contrasted with a mere piece of solvent-extraction machinery) for the solvent scouring of wool and the complete processing of the extracted components. In extenuation it should be noted, again, that despite six decades of active study there still is remarkably little information as to the composition of yolk, suint, and grease, and almost no information on their relative solubilities in different solvents.

We stated above that almost any type of solvent-scouring equipment can be made to do an adequate job of removing the desired amount of grease from wool. That is broadly true, but in detail, different equipment may offer quite different operating and maintenance difficulties, and the comment is to be understood as referring only to the workability of the extraction sections of the equipment, as contrasted with the wool-opening and solvent-stripping sections. In this connection, we note that the Smith-Drum equipment currently available has ample, and far more than adequate, extraction capacity for the amount of grease wool it is designed to process. It is of course, clear that, although any given piece of equipment can be made to work, it is not to be concluded that it will work economically or as conveniently as one designed for the purpose.

SELECTION OF SOLVENT——Probably every known fat solvent has been suggested for use in wool scouring, and it is probably true that any one of them would do an adequate job of removing grease from fibers, if that were the only requirement. Very little data has ever been advanced to suggest that there is any one solvent which has greater merit than another, except for cost, availability, or hazard. We discuss herewith only those solvents which have actually been used in large-scale, semicommercial installations, and those which have been recommended in the last few years for such work.

The earliest British and French sol-

vent scouring processes *(1, 17)*, which were tried out in the 1880's, employed acetone and ether and were immediately abandoned because of the terrific explosion and fire hazard. In the 1890's the British attempted large-scale production of solvent-scoured wool using carbon bisulfide as the solvent. This process failed, in part because the bisulfide was absorbed by the wool and gave it a permanent yellow color, and in part because in this process, as in all the early processes, the extraction was pushed too far, chemically or physically, leaving harsh, brittle fibers, which caused great waste in the subsequent spinning operations.

This is perhaps the place to emphasize that solvent scouring should remove only the grease on the surface of the fibers. There are natural grease or lubricating compounds deep within the cortex of the wool fibers whose removal is reported to result in a very harsh, brittle wool *(18, 19)*. It is not apparently generally realized that various solvents differ greatly in their power to penetrate and swell wool fibers and hence reach and remove these inner fatty constituents. Water, ether, and alcohols, are among the most penetrating of the solvents; benzene and hydrocarbons in general are among the least penetrating. This phenomenon is, at least in part, responsible for the widely different amounts of "grease" which can be extracted from grease wool. We have been unable to find any evidence that this question has been studied previously or considered in connection with selection of a solvent for solvent scouring. We will present data in another paper to indicate how important this phenomenon can be.

At the turn of the century the British tried petroleum ether as a solvent, and both British and American firms tried carbon tetrachloride. Both solvents failed because of the extreme embrittlement of the wool, produced by excessive extraction of grease or excessive handling, and the carbon tetrachloride process failed, in addition, because of the extreme corrosion of equipment produced by this solvent. About this time Erben and Harding at Philadelphia and the Arlington Mills at Lawrence introduced the use of naphtha as a solvent in the process which Arlington used until 1952. This is the only wool-solvent-scouring process which achieved the status of a long-continuing commercial operation. There have been several minor changes of solvent (naphtha to gasoline, to hexane and back to naphtha), but essentially the solvent remains as primarily a moderately low-boiling aliphatic hydrocarbon mixture (although the boiling point is substantially higher than that of petroleum ether, and the explosion hazard correspondingly lower). As we have noted before, the success of this process depended on using an aqueous alkaline rinse following the solvent scouring.

No large-scale efforts to use new solvents appear to have been made in the wool-scouring field until the commercial advent of the relatively inexpensive and nonflammable chlorinated hydrocarbons a decade ago. The increasing use of trichlorethylene in particular in the oilseed industry apparently led to its use in the Smith-Drum process. The use of this solvent, like the use of naphtha, appears to require that the wool be given an aqueous scour. In use, neither the naphtha nor the trichlorethylene processes appear to be particularly noteworthy for reducing the pollution problem inherent in wool scouring, although relatively little attention has been given to this problem until recently. Much of the pollution load in these processes comes from the grease-purification train, but it is inherent in any process which depends on an aqueous scour to remove suint and salts, because it appears that a large proportion of high-BOD components is associated with these yolk components.

Mineral oils (high-boiling hydrocarbons) have been suggested as solvents for wool scouring, and recently Hoffman has patented the commercial use of a scouring system in which a kerosene or modified kerosene is used as a solvent. The virtues of this type of solvent are low volatility, low cost, and relatively low flammability. No detailed technical information is available on the economics or practicability of this solvent, and its employment would seem to be dependent on the use of special equipment. The kerosene or mineral oils are not adapted to conventional solvent-extraction processes because their boiling ranges are high and very broad; consequently their distillation cost is prohibitive. Naphthas do not suffer from this drawback because, although they are not pure compounds, they are available in very narrow boiling ranges of almost any desired figure.

Recently a combination of methyl and ethyl alcohol has been suggested as a wool scouring solvent, because of its alleged efficacy in removing suint as well as grease, and because it is said that the grease components can be readily recovered from the miscella. Insufficient technical data have been released to enable evaluation of these solvents from a mill point of view. More recently it has been pointed out that the addition of butyl alcohol and other lower aliphatic alcohols to the conventional aqueous scouring system (essentially, therefore, a mixed alcohol-water solvent) may have advantages, but the experimental work has not been carried to the point where large-scale experimentation seems warranted *(15)*.

In general, all the solvents discussed have been recommended on the basis that they produce a satisfactory quality of wool or that they scour wool at relatively low cost, but little or no consideration has been given until recently to the question of their utility from either the grease-recovery or pollution standpoints. There has been a general feeling that a particularly good grade of grease could be produced by solvent extraction, in very high yield, but no accurate substantiating data have been provided to enable these claims to be evaluated. Recent work in our laboratories, to be reported later, has confirmed earlier laboratory work and extended it, to show that the total amount of matter extractable from grease wool by various solvents will range from ten to over thirty percent, and that these extractables are by no means all grease or capable of being recovered as grease. Further, we have shown that the problem of separating and refining grease extracted by solvents varies markedly in difficulty and cost with the solvent selected, and that the total yield of purified neutral grease, wax, or lanolin which can be recovered may not substantially exceed that recovered from the current aqueous scouring operations. This, of course, is merely a backhanded way of saying that there is very little information available on the relative solubility of the different components of yolk in various solvents; there is equally little information on the proportions of these various components in grease and suint, and there is practically no scientific data on the influence of variations in the proportions of those various components in the grease residue left in the wool on the subsequent processing of the wool. Correspondingly, there is no information as to the influence of these varied components on the distribution of BOD in the various fractions obtained in any grease purification process. Yet such data are essential for the proper evaluation of the economic practicability of any solvent-scouring system and, since aqueous scouring is in itself a form of solvent scouring, it seems likely that such data would shed valuable new light on the prospects of improving the aqueous scouring operations to either recover by-products other than grease or to reduce the total pollution load which must be handled by trickling-filter installations. We have determined some of this data and will present it in a series of further publications.

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(Concluded on page 911)

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Vice presidents, representing the Association's four regions, were elected as follows:

Central Atlantic Region———Frederick V Traut, Globe Dye Works Co

New England Region———Ernest R Kaswell, Fabric Research Laboratories, Inc

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Western Region———Joseph H Jones, Phoenix Dye Works

Mr Traut succeeds the late George L Baxter, and Mr Kaswell succeeds George O Linberg, Synthron, Inc, who has served the past three years as vice president (New England Region). Under Article V, Section 4 of the AATCC Constitution, Mr Linberg was ineligible for reelection.

Messrs Jacoby and Jones and Dr Scott are incumbents.

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NATIONAL CONVENTIONS

Sept 13-15, 1956 (Waldorf-Astoria, New York); 1957 (Boston); 1958 (Chicago); 1959 (Washington, DC)

HUDSON-MOHAWK SECTION

Jan 20 (Jack's Restaurant, Albany, NY); March 16 (Hotel Johnstown, Johnstown, N Y); May 18 (Ladies Nite); June 22 (Annual Outing).

MID-WEST SECTION

Feb 11 (Bismarck Hotel, Chicago, Ill); May 5 (Plankington Hotel, Milwaukee, Wis); June 16 (Outing—Browns Lake Resort, Burlington, Wis)

NEW YORK SECTION

Jan 27, Mar 2 (Hotel Delmonico, New York, N Y); Mar 23, Apr 27, May 18 (Kohler's Swiss Chalet, Rochelle Park, N J).

NIAGARA FRONTIER SECTION

Jan 20 (U S); Mar 3 (Canada—meeting to be held in conjunction wtih Ontario Section, CATCC); Apr 27 (U S).

NORTHERN NEW ENGLAND SECTION

Feb 17 (U S Quartermaster Research & Development Command, Natick, Mass); Apr 27 (Lowell Technological Institute, Lowell, Mass); Sept 28 (Annual Outing—Wachusett Country Club, West Boylston, Mass); Oct 19 (Science Park, Boston, Mass); Dec 1 (Annual Meeting—Hotel Vendome, Boston)

PACIFIC SOUTHWEST SECTION

Feb 6 (Gourmet Restaurant, Beverly Hills, Calif).

PHILADELPHIA SECTION

Jan 13 (Drake Hotel, Philadelphia); Mar 3 (Adelphia Hotel, Philadelphia); Apr 20 (Benjamin Franklin Hotel, Philadelphia); May 18 (Annual Outing)

PIEDMONT SECTION

Feb 4 (Poinsett Hotel, Greenville, S C); Apr 7 (Sir Walter Raleigh Hotel, Raleigh, N C); June 8-9 (Outing — Mayview Manor Blowing Rock, N C); Oct 6 (Annual Meeting—Hotel Charlotte, Charlotte, N C)

SOUTH CENTRAL SECTION

Dec 10 (Hotel Patten, Chattanooga, Tenn).

WESTERN NEW ENGLAND SECTION

Jan 27, Mar 16 (Rapp's Restaurant, Shelton, Conn); May 11 (Ladies' Night—Waverly Inn, Cheshire, Conn); June 15 (Outing); Oct 5 (Annual Meeting—Hartford, Conn); Nov 16 (Rapp's Restaurant, Shelton, Conn)

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(Concluded on page P910)

1955 National Convention——

THE SANDOCRYL PROCESS FOR THE DYEING OF POLYACRYLONITRILE FIBERS*

C H A SCHMITT, C W SAALFRANK and H R WALKER

Sandoz Chemical Works, Inc
New York, N Y

Much is known currently about the dyeing of polyacrylonitrile fibers by the cuprous-ion method. The Sandocryl method is a refinement of this process where metallic copper is used as the reducing agent in the bath.

This paper includes the advantages of the Sandocryl method over the old method, the type and amount of copper to be used, and the conditions of the dyebath to obtain the best results.

INTRODUCTION

BECAUSE of the possible scope of this paper, we shall limit the discussion of the process to the dyeing of Type-42 Orlon acrylic fiber in its different forms.

Dyeing by the cuprous-ion method is quite familiar to all who in the past have had some reason to dye the polyacrylonitrile fibers either alone or in conjunction with some other fiber. This method has filled a great need of the dyer and has made possible the dyeing of these fibers in fast heavy shades when nothing else would give the desired results. Ever since the introduction of this process by Feild and Fremon *(1)*, it has been recognized that here was a unique process in the field of dyeing that not only would revolutionize the dyeing of polyacrylonitriles but also pointed to an entirely different approach to dyeing problems. Because of the practicality of this type of reaction, much work has been done to try to make the process simpler, more versatile and accurate.

The operative principle is that, whereas acid dyestuffs have no affinity for polyacrylonitrile fibers in an acid bath, they are capable of dyeing these fibers in the presence of univalent copper ions. Only a limited number of acid dyestuffs, however, are applicable in this way.

The cuprous ions are produced in the dyebath itself by the reduction of cupric ions which are generally added in the form of copper sulfate.

HISTORY

In the earliest work, sodium and zinc formaldehydesulfoxylate, sodium bisulfite and glyoxal were used as the reducing agents to change the cupric ions into cuprous ions. These agents were so powerful however, that cuprous ions were formed faster than the fiber could absorb them and resulted in the deposition of free elemental copper on the fiber. Much work was done on the process by Blaker and Laucius *(2)*, and this resulted in an excellent explanation of the mechanics of the process as well as the discovery of better reducing agents than had been used heretofore. Their recommendation of the use of hydroxylamine sulfate proved to be a great step in the usefulness of the operation because of the slower speed with which this reducing agent supplied cuprous ions to the solution.

Even this new choice of reducing agent did not solve all of the problems, and again experimentation by Szlosberg *(3)* brought forth the so-called "drip method", whereby the hydroxylamine sulfate was added slowly to the boiling bath while the dyeing cycle was in progress.

In spite of all these innovations, there are still many faults with the process as all dyers of these fibers will testify. Again perhaps it will be well to outline the fault of the use of reducing agents in the bath.

If the total weight of the reducing agent is added at the start of dyeing, all the available copper is immediately reduced to monovalent form. The concentration of cuprous ions then becomes excessive and there is a consequent danger of over-rapid and uneven exhaustion. Even when the agent is added in several portions there are appreciable increases in the rate of dyeing immediately after each addition. Another objection to reducing agents is that many dyestuffs are partly degraded by their action, a factor which makes it difficult to obtain reproducible results. Moreover, when the cupric ions are reduced by an agent, there may be a decomposition of cuprous ions resulting in a precipitate of fine metallic copper.

The exact mechanism of the dyeing process is not fully known, but it appears that the absorption of cuprous ions by the fiber represents the initial phase of dyeing. Once the fiber has absorbed a cuprous ion, it is capable of absorbing a dyestuff ion. It follows that any unlevelness on this type of fiber must be due to a variable rate of copper absorption. The affinity of dyestuffs and cuprous ions is low at temperatures under 205-206°F but fairly high above this point. Consequently, an unduly heavy concentration of ions will cause uneven absorption and lead to unlevel dyeings. Our trials have shown that, once this occurs, the resulting unlevelness cannot be corrected. By adding the reducing agent in several lots the danger of unlevelness can be lessened to some extent. Even when this precaution is taken the risk of faulty dyeings is not eliminated, for it has been found that there is a sharp upward trend in the rate of absorption immediately after each addition of the agent. Moreover, this way of working complicates the whole dyeing operation.

In order to obviate these disadvantages, we have investigated possible alternatives to the cuprous-ion method and have developed in our research laboratories a proprietary method, the Sandocryl Process.

The authors of this particular paper are indebted to W Flugel, A Peter and H Egli *(4)* for their original work in developing this variation of the cuprous-ion method. Since their original paper on this subject, we have done considerable work on our own part, particularly in adapting it to its application to various types of equipment used here in the United States.

PRINCIPLE OF SANDOCRYL METHOD

The essential feature of our modified Sandocryl Process is that the reduction of the copper sulfate is brought about by copper metal instead of by a chemical agent. When copper metal is introduced

* Presented by C W Saalfrank in the Viking Room, Haddon Hall Hotel, Atlantic City, N J, on Sept 23, 1955 at a Symposium on Bringing Synthetics Up to Date.

into a dyebath containing divalent copper ions (copper sulfate), the following equilibrium is reached:

1 Cu-metal + 1 cupric ion = 2 cuprous ions

The quantity of cuprous ions thus produced is naturally small, since the equilibrium of the reaction lies well to the left of the equation. When polyacrylonitrile is present, however, it absorbs the cuprous ions as soon as they are produced and the metal-cupric ion system then starts to release a continuous supply of new ions. This kind of reduction precludes the possibility of a copper precipitation or degradation of the dyestuff. The quantity of cuprous ions produced per unit of time, and the resulting rate of color absorption, are directly proportional to the surface area of the metal and the concentration of the copper sulfate. The metal surface is calculated in square inches per gallon of dye liquor, and the copper sulfate in percentages on the weight of the goods. Sheet metal, which can be fitted into the machines may be used, or alternatively copper wire mesh or copper powder depending on the type of dyeing. The only necessary precaution is to see that when using sheet, wire or mesh, the copper does not come into contact with the goods, as this is apt to cause dark stains. When using copper powder this trouble is eliminated in that there is not a constant contact of fiber to metal, as the fine powder is in a steady state of movement through the dye liquor.

As is shown by the equation, of the reaction, part of the copper is used up as dyeing progresses.

The surface area of sheet metal remains constant for long periods of use, whereas that of wire and powder decreases more rapidly.

When, after several dyeings, the wire shows a loss in weight of about 50%, for example, its surface area will be approximately 70% of the initial value. Owing to this loss, the rate of dyeing is gradually retarded; at first it can be raised by increasing the copper sulfate, later by adding a proportionate weight of new wire.

FORM OF COPPER TO BE USED ——The choice of the type of copper to be used will depend to a great extent, as previously stated, on the kind of dyeing to be run, and should be of electrolytic purity.

In the dyeing of loose Orlon stock, copper sheeting is inserted under the false bottoms of the machine, or in the area between the bottom of the machine and the removable basket or plate supporting the Orlon stock.

In package dyeing machines, the installation of copper sheet is both simple and long lasting. (Inserted as an inverted crown or lining between the package carrier and sides of the machine).

In dye becks, the installation is easiest by using a series of copper plates joined in such a manner that circulation can take place between them. This is lowered into the front compartment or feed box area.

In the dyeing of certain materials where paddle or laundry machines are used, we have found that a suitable grade of copper powder can be used. Powder having such a large surface area makes it possible to dye deep shades using 1% of powder on the weight of the fabric working at a bath ratio of up to 50:1. The cost of the copper powder is sufficiently low enough to permit its complete loss during the dyeing cycle and rinsing operation.

AMOUNT OF METALLIC COPPER——

Plate — 30 square inches per gallon of dye liquor or a total surface area of 60 square inches per gallon.

Wire Mesh — 2/3 oz/gal of 30 gauge
1 1/3 oz/gal of 24 gauge
2 2/3 oz/gal of 18 gauge

Powder — 1-1½% on weight of goods

If plate or mesh are used, they are fitted into the machine and the machine is then loaded with the goods.

PRESCOURING ——The goods are scoured with either a nonionic or a crypto-anionic detergent for 20 minutes at 140-160°F.

ORDER OF ADDITION OF DYESTUFF AND CHEMICALS——

1) Add 1% (on weight of fabric) of a nonionic or crypto-anionic detergent
2) Add dyestuff while heating rapidly to 185°F
3) When bath has reached 185°F add acid to make pH 2.5, then
4) Add copper sulfate crystals.
(Step 2 and 3 can be reversed if pH must be determined colorimetrically.)

ACID——Either sulfuric or phosphoric acid may be used depending on the type of fabric to be dyed. Formic acid is not recommended.

COPPER SULFATE——The amount of copper sulfate to be used is, under most conditions, the same percentage on the weight of the goods as percentage of dyestuff.

TIME AND TEMPERATURE OF DYEING——After all the material has been added to the bath, raise to the boil in 30-45 minutes and maintain the bath at not less than 205°F until exhausted.

If the rate of dyeing is too slow it can be accelerated by further additions of copper sulfate. In high-temperature-dyeing machines, the same effect can be obtained by increasing the temperature to 215°F or higher. The temperature of the bath should be dropped to 190°F before further addition of copper sulfate.

RINSING AND SCOURING AFTER DYEING ——After rinsing, scouring should take place in the same manner as the prescouring.

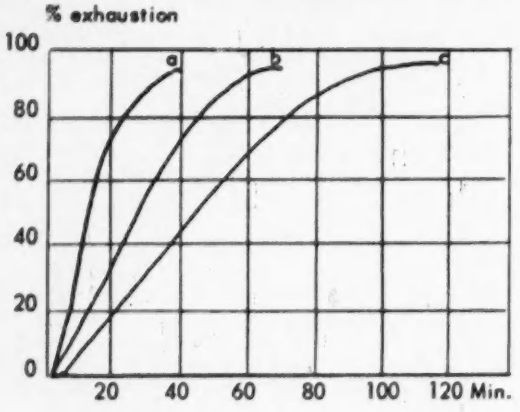
CHOICE OF DYESTUFFS——While many acid and direct colors can be dyed by this process, it has been proven to be of great value in dyeing a selected line of acid and special anthraquinone dyestuffs which possess outstanding fastness properties. A number of entirely new anthraquinone dyes have been especially developed for this method of dyeing. In the rest of the time allotted we will endeavor to point out some of the theoretical aspects of the Sandocryl Process as well as to indicate the best conditions under which it operates.

EFFECT OF VARIATIONS IN AMOUNT OF COPPER SURFACE ON RATE OF EXHAUSTION ——When the pH, the copper sulfate and the dyestuff remain constant, the rate of dyeing is directly proportional to the surface area of the copper. For instance, if 200 cm^2/1 of copper are exposed, exhaustion takes place in 40 minutes whereas if only 50 cm^2/1 of copper surface are exposed, exhaustion requires 2 hours (Figure 1).

EFFECT OF COPPER SULFATE ON THE RATE OF EXHAUSTION——If the pH, the percentage of dyestuff and the copper surface are kept constant, the rate of exhaustion can be controlled by the amount of copper sulfate present. The rate of exhaustion increases with an increased amount of copper sulfate. For instance, with 2% copper sulfate, exhaustion takes place in 40 minutes whereas with 0.5% copper sulfate, exhaustion requires 2 hours (Figure 2).

RELATION OF DYE CONCENTRATION TO RATE OF EXHAUSTION ——If the pH, the copper surface and the copper sulfate remain constant, there is a relationship between the rate of absorption and the quantity of dyestuffs used which indicates that the dyestuff is absorbed at a rate equal to the supply of cuprous ions. For instance if 0.5% dyestuff is used, it takes 40 minutes for exhaustion whereas if 2% dyestuff is used, 2 hours are required (Figure 3). More will be said about this matter later.

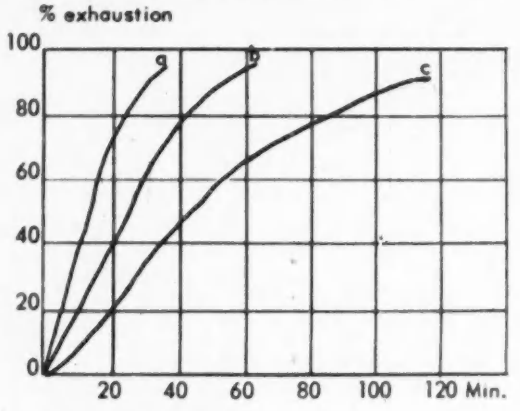
EFFECT OF COPPER SULFATE AND DYE CONCENTRATION ON THE RATE OF EXHAUSTION ——If the



Copper surface

Liquor ratio	: variable
pH	: 3
$CuSO_4 \cdot 5H_2O$	: 1%
Dyestuff	: 1%
Copper surface	: a. 200 cm^2/l
	b. 100 cm^2/l
	c. 50 cm^2/l

Figure 1



Copper sulfate quantity

Liquor ratio	: variable
pH	: 3
Dyestuff	: 1%
Copper surface	: 100 cm^2/l
$CuSO_4 \cdot 5H_2O$	: a. 2%
	b. 1%
	c. ½%

Figure 2

pH and copper surface remain constant, and if the percentage of dyestuff and percentage of copper sulfate vary in the same proportion, the exhaustion rates are practically identical. For instance, if 1% dyestuff and 1% copper sulfate are used, the exhaustion rate is almost identical to a system where 6% dyestuff and 6% copper sulfate are used (Figure 4).

Thus a uniform rate of absorption can be ensured by maintaining a constant copper surface area per gallon of liquor, and by a constant dyestuff to copper sulfate ratio. However, if the rate of dyeing is too slow, it can be accelerated by further additions of copper sulfate.

When dyeing medium to dark shades in short baths, it is preferable to work with less copper sulfate (one-half as much as dyestuff) at the cost of somewhat longer dyeing time. At the present time we believe that the copper sulfate should not be added below 185°F.

pH VALUE——No variations in the rate of dyeing are perceptible in the pH region 2.5-4, but below pH 2.5 the progress of dyeing seems to be somewhat slower. pH values above 4.5 are unfavorable.

IMPORTANCE OF ADDING ACID AT 185°F——It is well-known that many dyestuffs precipitate in dyebaths of low pH, especially when the bath is of high concentration and at low temperature. In our system we are operating at a pH of 2.5 to 3, and in short baths some of the preferred colors will precipitate at low temperatures. The dangers involved are well understood and Millson's (5) work with the Microdyeoscope has shown that dyebaths which on casual examination may appear only slightly turbid or opalescent, are actually in a state of fine precipitation. True, many will redissolve on elevation of the temperature, but in the interim trouble could develop on certain materials. Because of the chance for such precipitation with some dyes, we recommend adding the acid at 185°F, which is well above the ceiling level of possible precipitation. It is also good to point out at this time that many dyes are apt to be precipitated by copper sulfate in strong, cold acid baths which is another reason for our recommendation of adding both the acid and copper sulfate at 185°F.

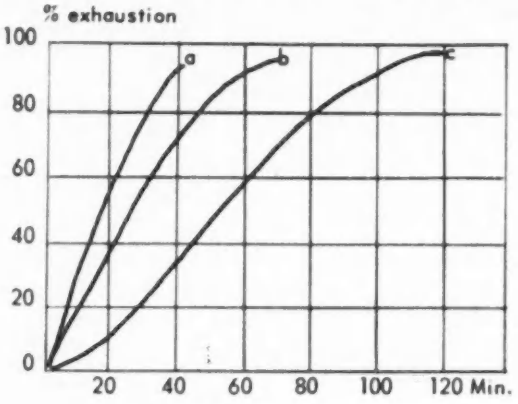
ADDITIONS OF COPPER SULFATE ——If more copper sulfate is required, the temperature of the bath should be dropped to 190°F before additions are made, and then brought slowly back to 205-207°F.

EFFECT OF TIME AND TEMPERATURE ON RATE OF EXHAUSTION ——After the acid and copper sulfate have been added to the bath at 185°F the temperature is raised to the boil in 30 to 45 minutes and maintained at not less than 205°F for 45-60 minutes or until bath is exhausted. It is good to mention at this time that there is no danger in this rapid rise of temperature because there is no absorption of dyestuff due to the lack of cuprous ions at this point.

Dye absorption starts slowly between 185 to 195°F. From 195 to 204°F there is a gradual pick-up of speed in the exhaustion. From 204 to 212°F the exhaustion rate then becomes quite rapid; therefore, temperature of 205 to 207°F is preferred for piece goods.

In all previous remarks we have indicated that copper sulfate exerts the prime influence on the rate of dyeing and exhaustion once we pass a temperature of 185°F. All of these previous recommendations for amounts of copper sulfate equal to the amount of dyestuff are to be applied to the slow-drawing types of dyestuffs. For rapid drawing colors, such as Sandocryl Red 5BLCI, Violet BLCI, Blue 5GLCI, Brilliant Blue BLCI, the copper sulfate can be reduced. On the other hand, when dyeing piece goods on the beck where a longer dyebath is used, it may be necessary to increase the copper sulfate to 1½ times the weight of the dyestuff. This is particularly true when dyeing sample or single pieces in large kettles.

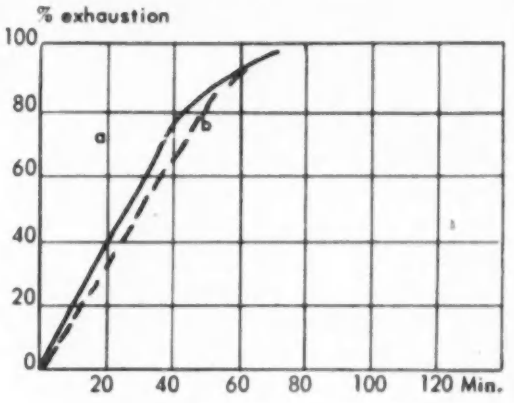
OXIDATION AND ITS PREVENTION ——A few dyestuffs tend to oxidize and fail to develop their proper shade when too much air penetrates the dyebath. This can be elimniated by the addition of ¼-½ oz of glucose per gallon of dyebath. However, in fully closed



Dyestuff quantity

Liquor ratio	: variable
pH	: 3
Copper surface	: 100 cm^2/l
$CuSO_4 \cdot 5H_2O$	: 1%
Dyestuff	: a. ½%
	b. 1%
	c. 2%

Figure 3



Dyestuff quantity

Liquor ratio	: variable
pH	: 3
Copper surface	: 100 cm^2/l
Dyestuff and $CuSO_4 \cdot 5H_2O$	
a. 1% and	1%
b. 6% and	6%

Figure 4

machines the chance for oxidation is so small that glucose can be dispensed with.

EFFECT OF GLAUBER'S SALT——— Glauber's salt exerts a retarding action in this method of dyeing, therefore, the most concentrated dyestuffs should be used. There are times, however, when certain colors exhaust too rapidly and the addition of 1 to 3% calcined Glauber's salt on the weight of the goods will slow down the initial strike. On continued boiling, final exhaustion will be complete.

MAKING ADDITIONS OF DYESTUFF———As in any other type of dyeing, it is better to make additions with the slower exhausting colors rather than the faster types. However, if proper precautions are taken, the so-called fast exhausting colors can be added by following these instructions:

1) Shut off steam and cool bath back to 185°F
2) Add dyestuff slowly and bring temperature back to 205-207°F or higher in no less than 20 minutes
3) Continue "boiling" for at least 15 or 20 minutes before sampling.

RINSING AND SCOURING OFF AFTER DYEING———At the completion of the dyeing cycle, the goods are rinsed, with the usual precaution taken for lowering the temperature slowly so as to avoid setting of crease marks and wrinkles, and then scouring with 1% of a nonionic detergent, for 20 minutes at 160°F followed by a light rinse.

FASTNESS PROPERTIES———Those dyes selected from the anthraquinone series and those which have been especially produced for application by this method are outstanding in their fastness properties on Orlon 42. The lowest light fastness rating of this group shows L6 to 7 in the Fade-Ometer in 0.25% dyeings, whereas the majority of them rate L7 or better. When exposed to daylight, the fastness is even greater. Many of the colors when dyed in light to medium depths will outrun blue standard L8.

In addition to having extreme fastness to light, these colors also possess excellent fastness to AATCC No. 3 wash test, acid and alkaline perspiration, crocking, severe milling and drycleaning. In other words, we believe that these colors, when applied to spun Orlon, open up a new field of fabrication, especially for outdoor fabrics where light fastness has to be of the very best and cannot be produced by other systems of dyeing.

SUMMARY

It is believed that the method of dyeing we have described eliminates the bulk of the criticism which has been placed upon the original basic idea of dyeing by the cuprous-ion method. It is natural that on first examination the necessity of copper installation may raise a protest, but as we have explained, this is a simple matter and entirely flexible. Once the machine is ready for dyeing, all the previous problems of control are eliminated and dyeing is carried out as easily as though a dyer were making an acid dyeing on wool. The need for covered and heated jigs for dyeing certain colors on acetate seemed to be a bit unusual when first presented, but the improved results soon made dyers forget their original complaints. By the same token, the carrier system for dyeing Dacron and the suggestion of hot oil or molten metal for dyeing certain fabrics raised initial criticism.

As in any new innovation, continued plant experimentation and actual production gradually eliminates any existing flaws which may not have been encountered or overcome in our experiments and early plant work. Trials run to date in various plants, both here and abroad, indicate considerable promise. As mentioned earlier, this new system when properly set up, makes the dyeing of Type 42 Orlon no more difficult than dyeing natural fibers with substantive colors.

REFERENCES

(1) Feild, T A, Jr and Fremond, G H, abstracts of papers presented at annual meeting of Textile Research Institute, November 16, 1950, New York.
(2) Blaker, R H and Laucius, J F, "The Copper Method for Dyeing Orlon Acrylic Fibers", *Am Dyestuff Reptr* 41, P19 (1952).
(3) Szlosberg, E, "Dyeing Orlon", *ibid* 41, P510 (1952).
(4) Flugel, W, Peter, A and Egli, H, *Textil-Rundschau*, October, 1954.
(5) Millson, H E, "The Microdyeoscope—Microscopical Observations on Dyeing", *Am Dyestuff Reptr* 44, P417 (1955).

ACTIVITIES OF THE LOCAL SECTIONS

NIAGARA FRONTIER———The Niagara Frontier Section held its final meeting of the year on December 2 with National Aniline Div, Allied Chemical & Dye Corp, Buffalo, N Y, as host. Dinner was served to 60 members and guests in the plant cafeteria.

George H Hotte, director of fiber sales and service at National Aniline, spoke on Caprolan, the firm's new nylon fiber. A tour of the new Research Building followed Mr Hotte's address.

Results of the election of officers for the 1956 season were announced as follows: *Chairman*———John Wallace, Supersilk Hosiery Mills; *Vice-chairman*———William Leyking, National Aniline Div; *Treasurer*———Anton Viditz-Ward, Van Raalte Co; *Secretary*———Kenneth H Lister, Canadian Industries, Ltd; *Councilor*———Bernard K Easton, Becco Chemical Div; *Sectional Committee*———Hans O Kauffman, Becco Chemical Div; Kelvin H Ferber, National Aniline Div; Arthur S Tigert, Resin Tex Ltd; Jean G Kern, National Aniline Div.

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RHODE ISLAND———The Annual Meeting of the Rhode Island Section was held on Dec 1, 1955 at Johnson's Hummocks Grill, Providence, R I, and the following officers, councilors, and sectional committeemen were elected to serve for 1956: *Chairman*———R F Caroselli, Owens-Corning Fiberglas Corp; *Vice-chairman*———Thorwald Larson, Carbic-Moss Corp; *Treasurer*———J William Timperley, Kenyon Piece Dye Works; *Secretary*———Charles F Stokes, Carbic-Moss Corp; *Councilors*———Francis H Casey, Sandoz Chemical Works, Inc; Raymond B Taylorson, Sandoz Chemical Works, Inc; *Sectional Committee*———David R Meikle, Stillwater Worsted Mills; Edward F Mulally, Jr, Queen Print Works; Raymond A Pingree, Crown Chemical Co; Reid Tull, Arnold, Hoffman & Co, Inc.

In attendance at the meeting were Raymond W Jacoby, national president, and George O Linberg, vice president (New England Region).

The technical program consisted of a short resume of the Section's 1955 Intersectional Contest Paper, which was awarded first prize at the Atlantic City Convention. Committee vice chairman William J Jutras, Jr, who presented the resume, also presided at a panel discussion of the paper. Panelists included James J Dillon, King Philip Finishing Co; Boris Frankfort, Glenlyon Print Works; C Eric Neale, Apponaug Co; Robert H Phillips, Cranston Print Works; John J Roarke, Bradford Dyeing Assoc; and Charles A Robinson, Arnold, Hoffman & Co, Inc.

Approximately 175 members and guests attended the dinner and business meeting.

* * * * *

RISD STUDENT CHAPTER———On October 13, 1955 the Rhode Island School of Design Student Chapter met to hear Herbert F Kilguss, Apponaug Co, discuss "The Textile Chemical Industry". Attendance was 35.

On October 27th, a meeting was held at which plans were made for a membership drive, which is now underway. Plans were also formulated in regard to future speakers.

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SOUTH CENTRAL———The South Central Section held its Fall Meeting at the Hotel Patten, Chatanooga, Tenn, on Saturday, December 10th.

Speaker at the Technical Session was Walter H Hindle, associate director of research in charge of dyeing and finishing for The Chemstrand Corp, who discussed the Dyeing of Acrilan.

Clyde Horne, superintendent of dyeing for Spindale Mills and Cherokee Textiles, was guest speaker at the banquet.

There were 65 in attendance.

* * * * *

WESTERN NEW ENGLAND———Approximately 100 members and guests attended the Nov 4th meeting of the Western New England Section at the Hotel Bond, Hartford, Conn.

Joseph Masselli, Department of Chemistry, Wesleyan Univ, spoke on "A Pollution Reduction Program for the Textile Industry".

OUTING PHOTOS

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Pacific Southwest Section

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Rancho Santa Fe, San Diego County, Calif

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September 24, 1955

(Photos courtesy of A H Roberts, Jacques Wolf & Co and S Springer, The Springer Co)

1—Mrs A H Roberts; H Ellsworth, West Coast Carpet Dyers
2—Mrs H Ellsworth
3—W Wright, Kelco Co; C Lindsey, UCLA
4—Mr and Mrs R Huston, Modern Dyers
5—S Dadone, L A Piece Dye; R Fliegel, Nat Dye & Finish; F Engels, Peerless
6—E Lindquist, outing chairman; M Kramer, golf chairman
7—M Kramer, Hollywood Hand Prints; W Jones, U S Testing
8—M Kramer, A H Roberts, Mr & Mrs Ellsworth
9—E Lindquist, Geigy
10—R Mishell & family
11—W Ingham, Nat Dye; Mrs Ellsworth; H Fenn, Nat Dye; H Ellsworth
12—W Wigglesworth, UPDW
13—Mrs F Ahlf; S Dadone; Mrs J McNiff; Mrs Nehmens
14—Mrs W Jones
15—Mrs W Campbell
16—F Thatcher, Modern Dyers
17—V Moore, Becco
18—Mrs F Thatcher
19—Mr & Mrs F Engels
20—Mr & Mrs J Smith; Mrs Lindquist

—♦ ♦—

Membership Applications——

(Concluded from page P902)

APPLICATIONS FOR TRANSFER TO SENIOR MEMBERSHIP

Ralph V Carlson
Robert J Cicione
Richard C Demuth
Richard A Gifford
Frank J Lachut
Malcolm Mackenzie, Jr
Gregory J Pelliccione
Lowell A Shive
Donald T Tweedy

STUDENT

Paul M Groshein—Provincial Inst of Textiles, Canada. Sponsor: D Cooper.
Lindsay E Liddle—Provincial Inst of Textiles, Canada. Sponsor: D Cooper.
Rahmat Ali—N C State College. Sponsor: H A Rutherford.
Laurence I Belkin—N C State College. Sponsor: H A Rutherford.
David S Bernzweig—N C State College. Sponsor: H A Rutherford.
Rino L Pellissier—Lowell Tech Inst. Sponsor: G R Griffin.
Francis Randelunas—Lowell Tech Inst. Sponsor: G R Griffin.
Sanae Sakaguchi—Lowell Tech Inst. Sponsor: G R Griffin.
Bobby L Harrell—Georgia Inst of Technology. Sponsor: W Postman.
Ana Brumlik—Philadelphia Textile Institute. Sponsor: W H Hughes.

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NOTICE TO AUTHORS OF PAPERS

MANUSCRIPTS for the *Proceedings* and for other publications of the American Association of Textile Chemists and Colorists shall conform to the requirements and standards given in this *Notice*. Before publication, manuscripts for the *Proceedings* shall be approved by the Editor, not only for editorial correctness according to the standards of this *Notice*, but also for content of technical matter. In his work, the Editor may enlist the aid of anonymous reviewers who are selected for expert knowledge in particular fields.

It is presumed that authors in studying the comments of reviewers and of the Editor will remember that all recommendations are made in a kindly, helpful, sympathetic manner to improve the paper in both literary and technical excellence. Although authors should cheerfully consider suggestions, they are expected to defend their position if justified, especially when strictly technical matters are involved with which the authors have an intimate knowledge.

MANUSCRIPTS—Manuscripts shall be typewritten double-spaced with approximately one-inch margins on 8.5 x 11-inch white paper. In addition to the *original*, at least one carbon copy is required. Pages are to be numbered consecutively with Arabic numerals, and each page after the first shall carry the authorship at the very top. Tables and figures shall also be numbered consecutively, the tables with headings containing Roman numerals as TABLE I, TABLE II, etc, and the figures with Arabic numerals as Figure 1, Figure 2, etc, appearing *below* the figures. The names of the authors and their laboratories or business connections should appear below the title of the paper.

ARTICLES APPEARING IN THE "PROCEEDINGS" IN RECENT ISSUES OF THE "AMERICAN DYESTUFF REPORTER" will be helpful to authors as models of form for the typing of manuscripts.

LITERARY STYLE AND FORM OF PRESENTATION—In the writing of papers, authors are requested to observe a trenchant, simple style of writing directed to textile chemists and colorists with at least an elementary knowledge of chemistry, physics, mathematics, engineering, textile processes and textile machinery.

In the organization of the material, there should be one or more introductory paragraphs setting forth the occasion, significance and main objectives of the paper and of the method of attack. This should be followed by the body of the presentation, either with discussions interspersed throughout this portion or with a collected section marked "DISCUSSION" after the main body of the paper. Finally, there may be a brief section at the end entitled "SUMMARY" of "CONCLUSIONS."

Center and side headings make for easier reading. Center headings should be employed sparingly and generally will include only very important section headings, such as "INTRODUCTION," "EXPERIMENTAL," "DISCUSSION," "CONCLUSIONS," "SUMMARY," and "REFERENCES." Side headings (see third paragraph of this *Notice* for an example) shall be indented and run into the text to which they apply, and shall be separated from the paragrpah by a dash. The publisher will print center headings in bold-face capitals and side headings in capitals.

LITERATURE REFERENCES AND FOOTNOTES—References to the literature and all footnotes (except those in tables) shall be numbered consecutively with underlined Arabic numerals in parentheses at the proper place in the text. Where a reference or footnote is to be used again, the original number is simply repeated; this obviates the necessity of repeating the footnote or reference at the bottom of the page. References to the literature shall conform to the universal usages followed by *Chemical Abstracts*, which include underlining of book and journal names to indicate italicization in printing.

The spelling and rules of punctuation followed in manuscripts shall be those found in the "Merriam-Webster New International Dictionary"; abbreviations and chemical formulas shall conform to *Chemical Abstracts*. Periods shall be used only at the end of sentences, not after abbreviations.

FIGURES AND GRAPHS—Figures and graphs should be black line drawings on white drawing paper. Photographic prints are acceptable, preferably glossy prints on double-weight paper. Duplicates should be available for dispatch to reviewers. Diagrams and graphs should preferably be designed in long form to cover one column of print but may be two columns wide or the width of a full page where necessary. In graphs the frame and actual curves should be inked more heavily than the co-ordinate lines, and these latter should not be too close together. Various styles of broken lines are sometimes desirable to distinguish curves. Experimental points should be given with small plane figures, such as circles, squares, diamonds or triangles. Numbers and legends on co-ordinate axes are to be lettered in the graph by the author. Numbers and titles of figures should be placed below the diagram or on the edge of the back. Each piece of illustration copy should bear on the margin or on the edge of the back the name of the author and the title of the paper.

Photographs of authors should be included with copy, to be run in conjunction with the paper. These must be on glossy stock, and should be large enough for proper reproduction.

TABLES—Tables should not be used indiscriminately because they are very expensive to set up in type. They should be designed to be one column, two columns or three columns wide. Tables should be arranged with the view of conserving space; column headings should be short and abbreviated. Quantity designations shall never appear in the body of the table but in the headings. Tables, if possible, should be placed in the manuscript where they belong rather than separately.

SYNOPSIS—A separately written synopsis of not over 200 words containing the gist of the subject matter must accompany every manuscript.

GALLEY PROOFS—Galley proofs will be sent to the author by the publisher for correction before publication. This should not be interpreted as an invitation to rewrite the paper but rather as an opportunity to correct errors.

REPRINTS—Fifty reprints of papers published in the *Proceedings* will be furnished without charge by the publisher if requested when galley proofs are returned. These reprints are printed on one side of the sheet only and then stapled together. A schedule of prices of reprints in the usual form accompanies the galley proofs.

OWNERSHIP OF COPYRIGHTS AND PATENTS—All papers presented at general meetings of the Association or at meetings of any of its local sections and all communications shall become the property of the Association. Such papers are not to be published elsewhere until they have appeared in the *Proceedings* of the Association. Papers published in the *Proceedings* are copyrighted by the Association. Any patentable disclosures shall of course remain the property of the author or authors.

TRADE-MARKS — As the AATCC wishes to co-operate in the protection of trade-marks, it is requested that, in the body of the article, trade-marks be written with an initial capital letter. Courtesy demands that authors include competitive products as well as those of his firm. Many current trade-marks are to be found in the "AATCC Technical Manual and Year Book".

Grease Wool——

(Concluded from page 900)

sion. We are greatly indebted to the management of Pacific Mills for permission to publish this work. We especially wish to acknowledge the constant advice, discussion and friendly criticism offered at all stages of this work by Harold W Leitch, then general superintendent in charge of research, John N Dalton, director of the Chemical Department, and George Cohen.

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GENERAL CALENDAR OF COMING EVENTS

AMERICAN SOCIETY FOR TESTING MATERIALS

Feb 27-March 2—Committee Week, Hotel Statler, Buffalo, N Y; Mar 13-16—Spring Meeting of Committee D-13 on Textiles, Warwick Hotel, New York, N Y; June 17-22—59th Annual Meeting and 12th Apparatus Exhibit, Chalfonte-Haddon Hall, Atlantic City, N J; Sept 16-22—2nd Pacific Area National Meeting and Apparatus Exhibit, Hotel Statler, Los Angeles, Calif; Oct 16-19—Fall Meeting of Committee D-13 on Textiles, Warwick Hotel, New York, N Y.

THE DRYSALTERS CLUB OF NEW ENGLAND

Jan 30 (Hotel Vendome, Boston, Mass); April 27 (Hotel Vendome, Boston, Mass); June 22 (Outing, Wachusett Country Club, West Boylston, Mass)

THE FIBER SOCIETY

Spring Meeting—May 2-3, The Clemson House, Clemson, S C; Fall Meeting—Sept 6-7, Warwick Hotel, New York, N Y.

THE INSTRUMENT SOCIETY OF AMERICA

11th Annual Instrumentation-Automation Conference and Exhibit—Sept 17-21, New York Coliseum, New York, N Y

NATIONAL COTTON COUNCIL OF AMERICA

7th Annual Cotton Research Clinic—Feb 15-17, Pinehurst, N C.

PERKIN CENTENARY

May, 1956—London, England.

PERKIN CENTENNIAL

September 10-15, Waldorf-Astoria Hotel, New York, N Y.

PHI PSI FRATERNITY

Annual Meeting—April 19-21, Alabama Polytechnic Institute, Auburn, Ala.

PLANT MAINTENANCE & ENGINEERING CONFERENCE

Jan 23-26—Convention Hall, Philadelphia, Pa

THE QUARTERMASTER ASSOCIATION

Annual Convention—Oct 27-28, Conrad Hilton Hotel, Chicago, Ill.

QUEBEC SECTION, CANADIAN ASSOCIATION OF TEXTILE COLORISTS AND CHEMISTS

Jan 21, Feb 18, Mar 17 (McGill Univ, Montreal, Que); Apr 20-21 (Annual Meeting, Sheraton Mt Royal Hotel, Montreal); June 16 (Annual golf tournament).

SOUTHERN TEXTILE EXPOSITION

19th Exposition, Oct 1-5, Textile Hall, Greenville, S C.

TEXTILE RESEARCH INSTITUTE

1956 Annual Meeting—March 22-23, Hotel Commodore, New York, N Y.

TEXTILE TECHNICAL FEDERATION OF CANADA

5th Bi-annual Textile Seminar—June 5-7 Queen's Univ, Kingston, Ont.

News of the Trade

• Becco Producing Anhydrous Hydrogen Peroxide in Commercial Quantities

The commercial development of hydrogen peroxide solutions in the concentration range between 90% and virtually 100% H_2O_2 content has been announced by Becco Chemical Division, Food Machinery and Chemical Corporation, Buffalo, New York. The invention and commercial development of a unique process for concentrating hydrogen peroxide solution, essentially continuous fractional crystallization, is covered in U S Patent 2,724,640, issued November 22, 1955, to G G Crewson and J R Ryan and assigned to Becco.

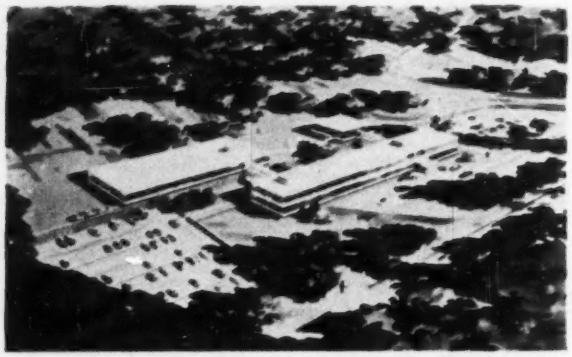
Becco's new process depends upon a continuous fractional crystallization, such that a solid phase of progressively higher hydrogen peroxide content moves in one direction through the apparatus, while a liquid progressively poorer in peroxide moves contrawise. The new process is said to be an ideal complement to fractional distillation, which is commercially practical only up to about 90% H_2O_2. The crystallization process is reportedly at optimum effectiveness when operated with 90% H_2O_2 feed stock. The take-off concentrations can be regulated to some degree, the practical maximum concentration being above 99.6% H_2O_2, it is reported.

Aside from the economical production of nearly anhydrous hydrogen peroxide, the crystallization process is said to also reject most of the impurities. The feed stock, Becco's 90% H_2O_2, reportedly meets ACS specifications for reagent grade 30% H_2O_2. Thus, the impurity level in Becco's nearly anhydrous H_2O_2, designated as SP "100" by the company, is said to be much less than that allowed by the current ACS reagent specifications.

The fractional crystallization process reportedly operates best to yield hydrogen peroxide of more than 98% H_2O_2 content. It is said to be practical to dilute this product to any desired concentration.

A preliminary bulletin (No. 70) and the related patent offer additional information. Technical data beyond the scope of the patent and the bulletin are not available at this time. Technical articles describing properties and production of virtually 100% H_2O_2 are anticipated for release in 1956.

Max E Bretschger, president of the company, states, "This is the end of the development. We are talking about impurities of infinitesimal amounts, unheard of concentrations of hydrogen peroxide, and produced in commercial quantity. It is a milestone in the history of the hydrogen peroxide industry."



Artist's sketch of Geigy Chemical Corp's new $3 million laboratory and office in construction at Mount Hope, N Y.

• New Geigy Lab Half Completed

Geigy Chemical Corporation's new $3 million laboratory and headquarters office is now half completed at Mount Hope, N Y on a landscaped 35-acre tract on the Saw Mill River Road between Hastings and Ardsley.

All of the buildings are of white reinforced concrete with exteriors of insulated white porcelain-enameled panels. White was selected by Geigy and designers of the architectural firm of Skidmore, Owings & Merrill to assist in the critical color matching which will be an important function of the dyestuffs laboratory. Windows will also be of clear instead of tinted glass.

Geigy Chemical Corporation, a subsidiary of J R Geigy, S A, Basle, Switzerland, has been prominent in the field of dyestuffs and textile auxiliaries for many years. Following the discovery of DDT insecticides by Dr Paul Mueller of the Geigy research staff in 1939, Geigy developed the DDT compositions, which saved many thousands of lives during World War II. More recently, Geigy has been marketing the new anti-arthritic drug, Butazolidin, and other pharmaceuticals. It has also developed a durable mothproofer, Mitin, and increased its production of industrial chemicals.

The project is nearly half complete and is expected to be ready for occupancy with an initial staff of 350 employees early next summer, according to spokesmen for the Corporation. The builders are Vermilya-Brown Company, Inc, of New York.

The cafeteria, administration building and part of the laboratory will be air-conditioned and the entire project will have automatic sprinklers for fire protection. The administration building contains an auditorium and lecture hall to accommodate 100 persons.

Since the original site was purchased, additional adjoining land has been purchased. More laboratory buildings are in the planning stage. A separate power house with sufficient capacity to serve present and future buildings is also under construction at the site.

• Catalin-Reichhold Merger Off

Catalin Corporation of America and Reichhold Chemicals, Inc have jointly announced that negotiations looking towards a merger between these companies have been discontinued.

• New AATT Committee to Study Expansion Possibilities

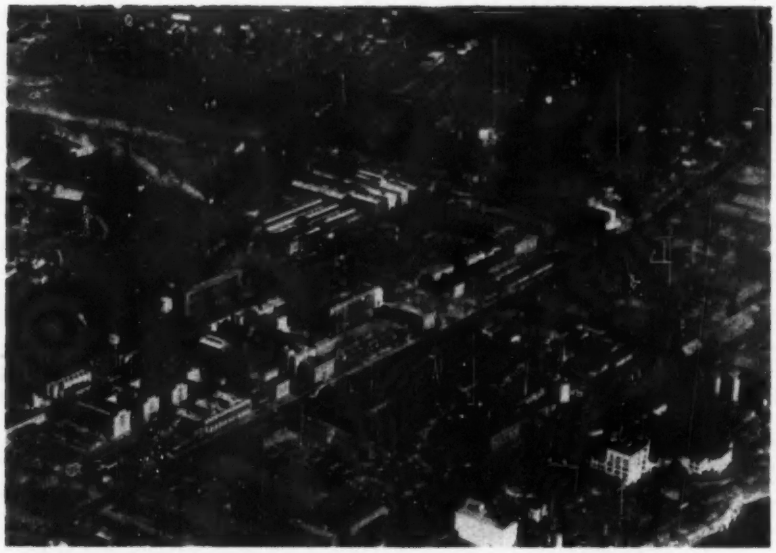
The Board of Governors of the American Association for Textile Technology, Inc, has named a committee to study the feasibility of providing for the establishment of regional chapters in various textile centers throughout the country.

The committee includes the following: Albert E Johnson, chairman, National Institute of Drycleaning; Roger Gentilhomme, Cluett, Peabody & Co; George H Hotte, Allied Chemical & Dye Corp; Alfred H McCollough, *Modern Textiles Magazine*; and L R Burgess, Reeves Bros, Inc.

The AATT was established in 1933. Its membership consists of technologists in the yarn and textile manufacturing industries.

• Mona Announces Production Boost

Mona Industries, Inc has announced a 300% boost in production capacity at its Paterson, N J plant, involving surfactants, detergents, wetting agents, emulsifiers, and dispersing agents.



Hooker Electrochemical Co, Niagara Falls, N Y—In foreground is plant of Niagara Alkali Co, which was merged into Hooker on Nov 30, 1955.

• Niagara Alkali Merged Into Hooker

Formal consolidation of Niagara Alkali Co, Niagara Falls, N Y, into Hooker Electrochemical Co, also of Niagara Falls, was effected upon the filing of a certificate of consolidation with the Department of State of the State of New York on November 30. This action followed an overwhelming vote by stockholders of both companies in favor of the merger.

Following the first meeting of the consolidated board of directors, R Lindley Murray, board chairman, announced that J Clark Cassidy, formerly president of Niagara Alkali, was elected a vice president and director of Hooker.

Niagara Alkali's facilities will be operated as the Niagara Alkali Division of Hooker, Mr Murray stated.

The $12,000,000 assets of Niagara Alkali now raises Hooker's total assets to more than $100,000,000, it is reported.

Hooker increases diversification in chemical manufacture by adding to its list of chlorine, caustic soda and more than 100 other chemicals Niagara Alkali's principal product line, caustic potash and potassium carbonate, as well as other products. Hooker also manufactures phenolic resins and several hundred phenolic moulding compounds produced at its Durez Plastics Division plants acquired last April.

• Cravenette-Kaplan Agreement

The Cravenette Company, USA, has consummated an agreement with Samuel Kaplan & Sons, New York, N Y, whereby Kaplan will have exclusive use of a new Cravenette finish and the Cravenette trademark for temp-resisto-insulated, and non-insulated lining fabrics.

The Cravenette finish offers water-spot, non-oily stain and perspiration resistance, and also water repellence, it is claimed. Cravenette processed lining fabrics will be identified by a special tag.

• Borden's Acquires Capital Stock of ARCC, Reslac

The capital stock of the American Resinous Chemicals Corporation, Peabody, Mass, and of Reslac Chemicals, Inc, Chicago, has been acquired by the Borden Company.

In announcing the acquisitions, Augustine R Marusi, Borden vice president in charge of chemical operations, said they were made to further diversify Borden's activity in thermoplastics. There will be no changes in management, operating procedure or personnel, Mr Marusi said.

The two chemical firms, with plants in their respective cities, manufacture a diversified line of products in the resins and plastics fields.

• PTI Accredited by CHE

The Philadelphia Textile Institute has been accepted to full accreditation by the Commission on Institutions of Higher Education of the Middle States Association of Colleges and Secondary Schools, according to an announcement this month by Bertrand W Hayward, president of the college.

Only since January 1, 1954 has this Association considered specialized institutions of higher education and PTI is among the first such institutions to be accredited by the Middle States regional association.

• Texize Purchases Rite Plant in Mauldin

Texize Chemicals, Inc, Greenville, S C, has purchased the Rite Manufacturing Company plant in Mauldin as a part of the firm's expansion plans, according to an announcement by W J Greer, Texize president.

The new plant will give Texize approximately 75,320 square feet more manufacturing space. In addition to the present two buildings of the Rite plant, plans have been drawn for a three-story mixing and manufacturing operation there. Construction of this addition will start as soon as possible, Mr Greer said.

The Mauldin plant is located on a 22-acre site on the Greenville-Columbia highway and on the mainline of the Charleston and Western Carolina railroad.

The original Texize plant is located on the White Horse Road in Greenville next to the new Piedmont and Northern Industrial Park. This first plant, plus several additions on a nine-acre tract, now comprise the manufacturing facilities. Mr Greer emphasized that this expansion will not mean closing this plant. The company's general offices will be maintained at the present location and the plant itself will be used for warehousing.

Texize was founded in 1946 and originally manufactured products for the textile industry only. Today the company has three major divisions: the Industrial Textile Products Division; Household Products Division and Commercial Products Division.

The McPherson Company of Greenville is handling the engineering on the new plant and the Daniel Construction Company will build the addition.

• Boston C of C Official Addresses CCNE

Donald J Hurley, president of the Greater Boston Chamber of Commerce, in an address last month before the Chemical Club of New England, stressed the importance of close cooperation of business groups in New England, particularly in their contacts with the federal government.

Speaking on the topic, "Boston, New England and the Days Ahead," Mr Hurley addressed a group of approximately 300 members and guests at the Sheraton Plaza Hotel in Boston. A question-and-answer period followed.

Mr Hurley was introduced by Morton S Johnson of Solvay Process Div, Allied Chemical & Dye Corp. Entertainment Committee members included T Fred Baker, chairman, Fritsche Bros; Charles Hoye, Jr, Whittemore Wright Co; and Loring Litchfield, E I du Pont de Nemours & Co, Inc.

• Radiant Heat Enterprises, Inc Formed

Radiant Heat Enterprises, Inc, a new organization formed by a group of sales and engineering associates until recently with Sill Industries, has established sales offices at 623 Morris Ave, Springfield, N J.

The group is comprised of Thomas F Walsh, sales manager, Chung Sheng Na, textile engineer, and Bruce Boden, all of whom specialize in textile finishing applications. They are currently adding to the staff.

The new company is marketing the electro-ceramic radiant heater designed by Mr Boden. This heater, which was introduced in 1953, is the basic unit in the stabilizing, drying and curing systems which RHE is building.

• Reduced Prices for Two Amines Announced by Rohm & Haas

Reductions in the prices of tertiary-butylamine and Primene 81-R were announced earlier this month by Rohm & Haas Company. The former is reduced by nearly twenty cents a pound and the latter by seven and a half cents a pound.

Effective December 6, fob Houston, the reduced prices per pound are as follows: tertiary-butylamine, tankcars and tanktrucks, forty-five cents; carloads and truckloads in drums, forty-seven cents; less than truckload in drums, forty-seven and a half cents. Corresponding prices for Primene 81-R are thirty-five, thirty-seven and thirty-seven and a half cents respectively.

• TCCA Name Change

The members of The Textile Color Card Association of the United States, Inc voted this month in favor of changing the organization's name to The Color Association of the United States, Inc.

This official action was taken at the special meeting held at the organization's headquarters, 200 Madison Avenue, upon the recommendation of the Association's directors, who unanimously favored the change. The new name goes into effect immediately.

In giving the reasons for this change of name, John M Hughlett, president, explained that in the early years of the Association, founded in 1915, it served primarily the textile and related fashion trades. Now, because of the increasing importance of color in more and more segments of industry, the scope of the Association's membership is constantly broadening, he said. In addition to the women's and men's fashion trades, it now serves many other branches of industry.

• Hilton-Davis Celebrates 1st Year in Providence

The Hilton-Davis Chemical Company, Cincinnati, held an open house for the textile industry in Providence, R I, on November 18 to mark the first anniversary of its regional distribution center and technical service laboratory in the New England area.

The affair was attended by management executives and technical representatives of textile dyeing, printing and finishing firms throughout the region. Accompanied by their wives, they were escorted on a guided tour of the facilities by Nelson S Knaggs, vice president in charge of sales, and members of the center's staff. One of the focal points of the inspection were the modern research laboratories.

Following a cocktail reception at the Hilton-Davis center, guests were entertained at a dinner held in the Pawtucket Country Club. Highlight of the evening was the showing of a new all-color motion picture, "Cairo to Fuji." The film, photographed and narrated by Mr Knaggs, portrayed the features of his 38,000-mile trip around the world, with major emphasis on Egypt, India, Thailand and Japan. Mr Knaggs is a director of the Cincinnati Museum of Natural History and a member of the Explorers Club.

Representing Hilton-Davis at the "open house," in addition to Mr Knaggs, were: Donald Eccleston, manager of the Providence regional center; William Green, sales manager; Hersey Howard, director of laboratory research; and Willard Sharp, manager of sales, mid-Atlantic states.

• New Chromium Oxide Facilities

The Geo B Smith Chemical Works, Inc, Maple Park, Ill, has announced the completion of facilities to further increase the capacity and production of their chromium oxide plant. The company is presently manufacturing pure, sulfur-free chromium oxide and also a complete line of dry colors.

They estimate the new facilities will double their chromium oxide production.

ADR AVAILABLE ON MICROFILM

Arrangements are being continued with University Microfilms, 313 North First Street, Ann Arbor, Michigan, for supplying subscribers of the Reporter with a microfilm edition. This arrangement was effective with the 1952 volume. The film copy will be delivered at the end of the volume year for those who subscribe to the service and it will include all issues published during that period. It is estimated that the film edition requires only 5% of the space required for the paper edition, which is bound. Complete information is available from University Microfilms.

• Yankee Instrument Fair and Symposium

The latest in instruments, related equipment and accessories for process control in industry and for laboratory and scientific measurement will be presented by the Instrument Society of America—Boston Section, Inc, at the two-day Yankee Instrument Fair & Symposium at Boston's Sherry Biltmore Hotel January 10 and 11.

In addition to the exhibit a selection of technical authorities will present papers on the electrical and pneumatic aspects of instrumentation and control with emphasis on research, design and application. Many manufacturers of instruments, control accessories, and measurement equipment will have their latest developments on display. A large section will be devoted to research and laboratory equipment.

Further information or registration forms may be obtained from ISA-Boston Section, Inc, Box 282, Boston 1, Mass.

• FRL Open House

Leaders in the textile, leather and paper industries were afforded the opportunity to view the newly established facilities of Fabric Research Laboratories, Inc, at Dedham, Mass last month.

Visitors were able to view laboratory tests under actual operating conditions. Attracting most attention were a new compressive shrinkage machine, on which foreign patent negotiations are pending, and a tester for studying the biaxial behavior of fabrics.

The building, of modern red brick construction, contains 16,000 square feet of laboratory and office space. It is located in Dedham at the junction of Routes 1 and 128, approximately 10 miles from downtown Boston.

The office wing contains a lobby, administrative and staff offices and conference rooms. In the laboratory wing are the library, luncheon and recreational facilities, physical, chemical, microscopical and analytical laboratories, pilot plant, and shop. The entire building is air conditioned.

Fabric Research Laboratories, Inc, was organized in 1942. Ernest R Kaswell is president, Kenneth R Fox and Milton M Platt, vice presidents, and Walter J Hamburger, director and treasurer. Its current staff numbers more than 40 scientists and engineers, under the direction of Dr Hamburger, with Messrs Kaswell, Fox, and Platt, associate directors, and George Thomson, assistant director.

The new building was designed by Chauncey C Chu, a senior research associate at Fabric Research Laboratories, Inc. Krokyn and Browne of Boston were the architects, and Canter Construction Company of Brookline, Mass, the builder.

• NEW PRODUCTS AND DEVELOPMENTS •

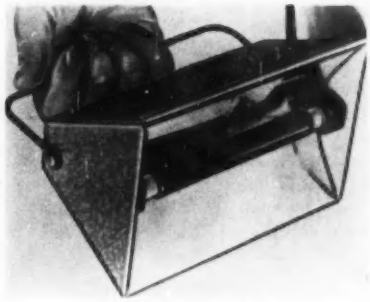
• Process for Making Nitric Acid from Atmosphere Described

Details of the operation of a semi-commercial process for making nitric acid directly from the atmosphere were described at a two-day symposium concluded last month at the Westchester Country Club, New York. The symposium was jointly sponsored by the Food Machinery and Chemical Corporation and the Wisconsin Alumni Research Foundation.

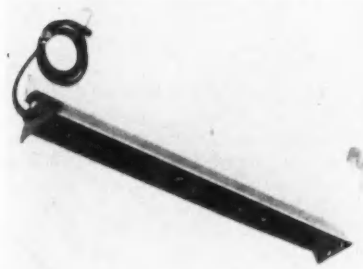
FMC and WARF cooperated in the development of the process, which reportedly resulted in a 40-ton-per-day plant built and operated by FMC for some eighteen months at Sunflower Ordnance Works, Lawrence, Kansas for Army Ordnance. Farrington Daniels, University of Wisconsin, presided at the Westchester symposium. Representatives of government departments and a wide cross-section of industry were in attendance at the two-day meeting.

Early work on high-temperature fixation of nitrogen to yield oxides of nitrogen and nitric acid began at the University of Wisconsin under the direction of Dr Daniels in 1939 at the suggestion of Frederick G Cottrell. There it was found that temperatures of the order of 3900°F could be achieved and good yields of nitric oxide could be obtained in a regenerative pebble-bed furnace. The Wisconsin work was financed by the WARF. Food Machinery and Chemical Corporation assumed responsibility for the development of a large-scale process in 1946. Following the building of a number of pilot-scale furnaces, the moving-bed principle was developed, which eliminated the sintering and plugging problem inherent in fixed refractory pebble beds. The Sunflower plant also made use of an improved and unique recovery system, based on the use of fluidized solids in recovery and concentration of the dilute oxides of nitrogen. Following the production of 2,400 tons of equivalent 100% nitric acid at Sunflower, the semicommercial plant was shut down by mutual consent, all important data having been obtained.

Although further development will be required to realize the economic advantages for large scale use, widespread industrial interest led to the calling of the two-day nitrogen symposium at Westchester. Among those participating in the program were Ernest Hart, executive vice president, FMC Chemical Divisions; Carl F Prutton, vice president, FMC, and technical director, Chemical Divisions; Emil Ott, director of central chemical research, FMC; E C Ermene and A C Peck of FMC; and W G Hendrickson and M D Woerpel of WARF.



Blak-Ray Model X-4



Blak-Ray Model XX-40

• Application of Ultra-violet Lamps in the Textile Industry

Several applications for their ultra-violet lamps in the textile industry have been cited by Black Light Eastern Corp, 33-00 Northern Blvd, Long Island City 1, N Y. The Company handles the Blak-Ray, a long-wave U-V lamp which emits at 3660 Angstrom units, and the Mineralight, a short-wave U-V lamp which emits at 2537 Angstrom units.

Inspecting fibers and fabrics — It is claimed that Blak-Ray will detect chemical difference or deterioration of various kinds and textures of textile fibers and fabrics.

Dye mixes — With the aid of Blak-Ray, it is claimed, differences are revealed in dye batches that are invisible to the naked eye. It is therefore said to be an aid in bringing batch mixes closer to color standard.

Inspecting raw cotton — Visual difference in fluorescence under Blak-Ray reportedly will detect dye-inhibiting types of raw cottons (immature, cat-eye, or "California" cotton). It is claimed that Blak-Ray may also reveal raw cotton that has different dye acceptances due to variance of crop to crop, area to area in cotton fiber with otherwise the same physical characteristics. Thus, in grading raw cotton bales, proper separation can be made, controlled blending initiated, and some types of finishing seconds (streaks, filling bands, etc) controlled or prevented, it is stated.

Detection — Blak-Ray will detect flaws, foreign substances (organic and inorganic) and other contamination in fiber, yarn and fabric, in the gray or as finished goods, it is claimed.

Laboratory use — Blak-Ray and Mineralight can be used in laboratories for comparison and analysis techniques. The luminescence and radiation of matter under these U-V rays reportedly enables the presence or absence of many substances to be determined.

Quality control — Blak-Ray can be utilized as a more efficient quality-control, tool in spinning, weaving and finishing operations, it is claimed.

Invisible marking systems — Blak-Ray lends itself to various invisible marking systems for inspection, identification, positioning, detection, etc.

The Model X-4 lamp sells for $16.75 and the Model XX-40, for $65.75. Complete information and literature may be obtained from the manufacturer on request.

• Synthrapol KB

Developed primarily for use in wet processing of textile yarns and fabrics, Synthrapol KB is a new product of the research laboratories of Arnold, Hoffman & Co, Inc, Providence, R I. It is described as a 97%-active, nonionic surface-active agent and, it is reported, because of its general compatibility, it is rapidly gaining acceptance in numerous diversified fields as an all-purpose detergent.

Desirable characteristics, which the new wetting agent is said to retain over a wide temperature range, include exceptionally good detergency, excellent solubility, and extremely fast wetting. The new Arnold, Hoffman product is claimed to be very resistant to hydrolysis and to exhibit a high degree of stability and effectiveness in acidic solutions. It is also said to be resistant to the effects of most alkalis and salts.

Use of Synthrapol KB in desizing operations is said to reduce the time of treatment by as much as 50% and to result in practically complete removal of starch and decomposition products from the fiber.

Small amounts of Synthrapol KB reportedly are very effective for soaping off and cleaning up stained prints. Being chemically inert, the new wetting agent is suitable for use in dye liquors, and is said to be of particular value both in the application of basic dyes and in the development of naphthol dyeings. It is claimed that, unlike many wetting agents, it does not precipitate basic dyes, and the pres-

ence of Synthrapol KB in developing baths reportedly overcomes the tendency of naphthol-prepared fabrics to float.

It is claimed that practical, large-scale trials have proved Synthrapol KB to be remarkably efficient as a kier-boiling assistant. Its presence in the kier reportedly insures rapid and intimate contact between the caustic soda and the fibers.

Literature describing practical applications of the new wetting agent is available from the company on request.

• New BASF Products, Pamphlets, Pattern Cards

Nova Chemical Corp, 147-153 Waverly Place, New York 14, N Y, exclusive distributors for Badische Anilin & Soda Fabrik AG, Ludwigshafen a Rhein, Germany, has released the following announcements of new shade cards, new pamphlets, and new products manufactured by their principals, the BASF:

BASF Products for the Textile Industry — Part IX, for Garment Dyeing and Drycleaning———In this brochure Badische Anilin & Soda-Fabrik AG has compiled the dyestuffs, detergents and auxiliaries, including stripping agents and other chemicals of their range, which are of special interest for use in garment dyeing and drycleaning.

Antistatin TT———This is the first member of a BASF range of antistatics. It is recommended by them for use with oiling, sizing, aftertreating and finishing agents. This antistatic is intended mainly for application to synthetic fibers to facilitate their spinning, weaving and knitting.

BASF Softener HS———This product is said to be one of the leading softening agents for textiles. In view of its antistatic properties, it is also employed as an antistatic for synthetic fibers, and also for natural and other man-made fibers.

BASF Softener TS———This finishing agent is said to be very economical in use, and to be particularly suitable as addition to sizes and finishes based on starch.

Lufixan LF———Lufixan LF is a new cation-active aftertreating agent of the BASF for improving the wet fastness properties of goods dyed or printed with direct and wool union dyestuffs. It is stated that, in view of its high efficiency and its almost complete lack of influence on the shade and on the light fastness of dyed or printed goods, Lufixan LF occupies an almost unique position among cation-active aftertreating agents of this type.

Fixapret IL Granular, Fixapret IL Paste———These two brands are different concentrations of the same product, which reportedly acts as an impregnating agent and, at the same time, imparts a firm hand to the treated fabric. This is said to be a most unusual combination of properties, since finishing agents which impart a firm hand generally impair the water repellent effect to some extent. The Fixapret IL brands are applied from organic solvents, eg, chlorinated and other hydrocarbons, and the main field of application is the finishing of heavy fabrics, including repair work and reimpregnation of used fabrics. Since these products are insoluble in water, the finished product exhibits excellent fastness to weathering and outstanding durability, it is claimed. Fixapret IL Granular and Paste are also of some interest as finishing agents (with water-repelling properties) in drycleaning.

Thickening V extra———This is a thickening agent for cloth printing. Like the older brand Thickening HD, this new product is a lignin-containing cellulose glycolate and is recommended by BASF for use in machine, screen and block printing. When applied to the fiber, Thickening V extra does not become brittle on drying, it is claimed. It is said to be readily removed by washing and to produce highly satisfactory levelness and good penetration in direct and discharge printing. Thickening V extra is employed mainly for the following classes of dyestuffs: vat colors, Nova soluble vats and analagous dyestuffs, Nova stabilized azoic colors and analagous dyes, and direct and acid dyestuffs.

It may be used either alone or in combination with other thickening agents.

"BASF Acetate Yellow 5GS, BASF Acetate Developed Black GL and AZN"———In this circular, the Badische Anilin & Soda-Fabrik AG announce that they have placed these three new acetate dyestuffs on the market.

BASF Acetate Yellow 5GS is the most greenish yellow of this range, which is dischargeable to white.

BASF Acetate Developed Black GL, developed with Developer ON, reportedly dyes relatively light fast navy blues with good fastness to wet treatments. It is said to be dischargeable to white except in deep shades, and to leave the cotton or viscose components of union fabrics almost unstained.

BASF Acetate Developed Black AZN, developed with Developer ON, dyes a very attractive black on both lustrous and delustered acetate. This dyestuff can also be discharged to white except in deep shades, and hardly stains cotton or viscose components in unions with acetate, it is reported.

"Pilate Fast Dyestuffs on Carpet Yarns"———This new pattern card illustrates the dyestuffs of this range in two depths of shade. It also contains a wide selection of compound shades which will be of assistance for the dyer of carpet yarns.

"Basolan Chrome Dyestuffs"———In July, 1955, the BASF issued this new pattern card in looseleaf form. It contains a detailed description of the methods of applying these dyestuffs and illustrates the shades of the individual brands on wool, nylon or perlon in three depths of shade. It gives evaluations of the fastness properties. The card also contains data on the fastness to heatsetting of the chrome dyestuffs and their suitability for printing, and indicates those brands which can be chromed with small amounts of potassium bichromate.

"Dyeings on Coir Yarns"———This new edition illustrates the shades of the well-known older dyestuffs for coir and also of some newer dyestuffs belonging to recently developed ranges which have already established themselves in the field of coir dyeing. In addition to acid and basic dyestuffs, dyeings with Neopalatin brands are included. The last-mentioned dyestuffs are said to have proved very popular for dyeing coir yarns, especially in fashionable pastel shades, in view of their very good fastness to light and the slightly acid method of application, which is particularly suitable for this fiber. The text of this pattern card gives recipes for dyeing, bleaching, partial stripping, and tips on improving the penetration and preventing the "masking" of reds on coir.

"Perliton Dyestuffs on Perlon or Nylon"———This is a further pattern card in looseleaf form. Perliton dyestuffs are water-insoluble disperse dyestuffs which are said to exhibit with exceptionally good leveling, good fastness to light and good fastness to wet treatment. The Perliton range is illustrated in two depths of shade. The pattern card also includes 60 fashionable shades, which will be of assistance to the dyer in formulating his recipes.

• Depcosoft D

The De Paul Chemical Co, 44-27 Purvis St, Long Island City, N Y, has announced the completion of its research and development on Depcosoft D, a new cationic softener in powder form.

Prepared as a cream-colored powder, Depcosoft D reportedly will aid greatly in the convenient handling and storage of finishes. It is claimed that stability is greatly improved in this "easy-to-use" form.

Depcosoft D is of the nonyellowing type and gives an extremely soft hand even when used in low concentrations, it is claimed. Solubility is said to be excellent, requiring only the addition of warm water. It is reported that no high-speed mixing is needed.

Depcosoft D is said to have proved itself an outstanding softener for all the leading synthetic fibers, and it is also said to be perfectly compatible with the various crease-resistant resin finishes.

When quality counts . . .

it pays to go to a specialist

WHEN Q TO

THE INDEX
TO THIS VOLUME HAS BEEN REMOVED
FROM THIS POSITION AND PLACED AT
THE BEGINNING OF THE FILM FOR
THE CONVENIENCE OF READERS.

COLOR

This record of leadership assures highest quality performance when you specify these famous, exclusive Althouse dye specialties:

Superlitefasts	Nylanthrenes
Azoanthrenes	Nydyes
Supernylites	Sol-Aqua-Fast

ALTHOUSE

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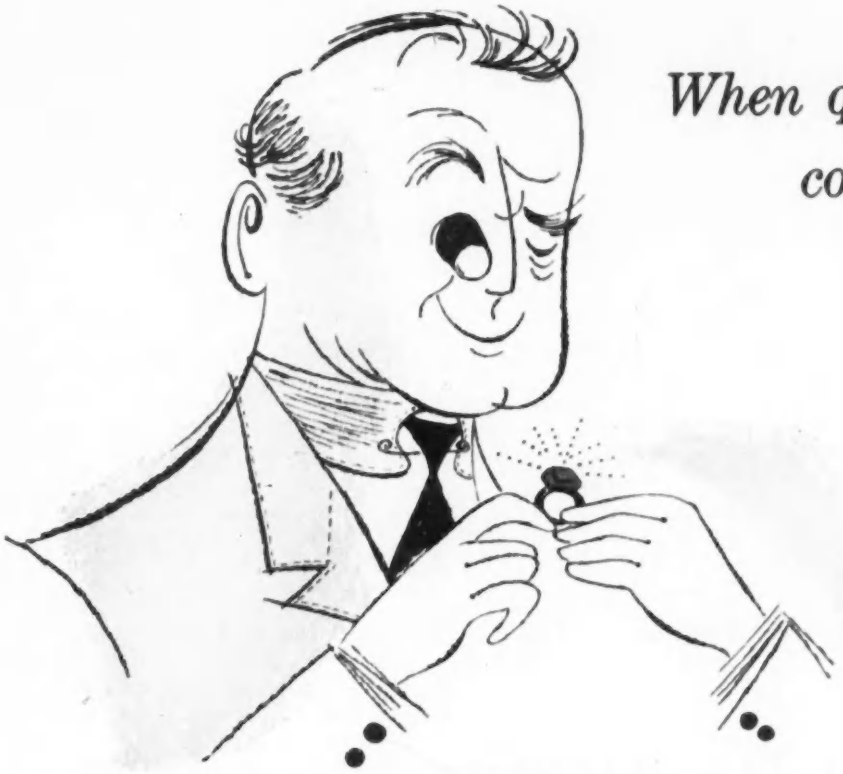

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it pays to go to a specialist

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Leading Specialists in Dyes for Cotton — Rayon — Nylon and Other Synthetics and **blends**
For 40 years Althouse research has pioneered in raising textile industry standards of

COLORFASTNESS

This record of leadership assures highest quality performance when you specify these famous, exclusive Althouse dye specialties:

Superlitefasts	Nylanthrenes
Azoanthrenes	Nydyes
Supernylites	Sol-Aqua-Fast

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worried about
WETTING AGENTS
in goods to be treated with
Water Repellents?

Forget your fears!
Use **ATOLENE NR**, the wetting agent and dye leveller **without re-wetting properties.** Even small amounts carried over from dye bath will not affect spray ratings of goods treated with water repellents. Write for information.

TEXTILE CHEMICAL DIVISION OF
dexter CHEMICAL CORP.
New York 59, New York
Boston—Charlotte—Atlanta—Greensboro—Buenos Aires

CLASSIFIED ADVERTISEMENTS

Advertisements in this section are restricted to HELP WANTED—POSITIONS WANTED—EQUIPMENT wanted or for sale. Rates, effective February 1, 1951: One-time, $10.00 per column inch; 3 consecutive times (same copy), $9.00 per column inch; 13 or more times, $8.00 per column inch; Position Wanted, $2.00 per column inch. Figure 38 average words per column inch. Publisher reserves the right to reject or discontinue any classified advertisement. Replies should be addressed: Box Number . . . c/o American Dyestuff Reporter, 44 East 23rd Street, New York 10, N. Y.

ABSTRACTING SERVICE—Abstracting and digesting of foreign patents and periodicals. Literature review and special reports in dyestuff and cellulose chemistry. PAUL WENGRAF, 88-36 ELMHURST AVENUE, ELMHURST 73, NEW YORK.

A New England company engaged in the manufacture of dyestuffs and auxiliary products, has vacancies in its Technical Service Department for Junior Technical Officers. Applicants should hold a degree in Chemistry, Applied Chemistry, or Physical Chemistry, and post-graduate experience is desirable. Some knowledge of dyeing, printing and finishing of textiles is desirable but not essential. All members of our Technical staff have been informed of the insertion of this advertisement. Write Box No. 125.

POSITION WANTED: If you require an aggressive person with imagination and know-how for Technical Service Development, or Technical Sales in any branch of textile industry, please contact this individual. Ten years' experience as laboratory supervisor, dyer, finisher, management. Textile college graduate. Write Box 980.

POSITION WANTED: HOSIERY DYER. Will go anywhere, capable of taking full charge of dyehouse. Experienced in dyeing of all kinds of fibers. Write Box No. 133.

POSITION WANTED: PRINT SUPERVISOR-COLORIST. Extensive experience on machine printing of cottons, rayons and synthetics. Proven ability taking charge of printing and color-shop departments. Age 42. Write Box No. 134.

A New England company engaged in the manufacture of dyestuffs and auxiliary products, has a vacancy in its Technical Service Department for a Senior Technical Officer, and applications are invited. The applicant should hold an honors degree in Chemistry or Physical Chemistry and post-graduate experience. Details of industrial experience should be stated, and preference will be given to applicants with experience with vat dyes. A successful applicant must be able to direct junior staff in investigational projects. All members of our Technical staff have been informed of the insertion of this advertisement. Write Box No. 124.

WANTED: DYER, to take charge of dyeing department of new American mill in Brazil, located in large modern city. Must have extensive experience and broad knowledge of box, jig and pad dyeing of spun synthetics and wool blends. This job offers exceptional opportunity to right man to join a growing and progressive company. Customary foreign service arrangements and all travel expenses for man and family. Must be willing to teach and train local labor. Knowledge of Portuguese or Spanish an advantage but not a necessity. Write full details to Box No. 131.

DYER-CHEMIST WANTED: By leading mill specializing in fine woolens and cashmeres. Yarn and stock dyeing. Must be aggressive and thorough. Age 30-45. Top salary and secure future for a well-qualified man. State education and experience fully in your first letter. All replies held confidential. Write Box No. 122.

LATEX CHEMISTS WANTED for expanding service and processing field. Excellent opportunity for two young qualified chemists to work under direction of research head. Replies should describe education and experience in latex compounding. Wica Chemicals, Inc., Charlotte, N. C.

● Classified Advertisements ●

PRODUCT DEVELOPMENT: Concern in Northern New Jersey has an opening for a person with a bachelor degree in either Chemistry or Chemical Engineering to work on the development of products based on fibers, resins or allied fields. One or two years experience desired. Work will involve the development of new and existing products. Write Box No. 140

TECHNICAL SALES SERVICE — established organic chemical manufacturer needs intelligent, energetic man to further development and sales in Southeastern U. S. Age, 27-37 preferred. Contacts, mostly textile industry, other industries to some extent. Good salary, plus incentive, plus expenses. Residence in Atlanta — Greenville, S. C. — Charlotte area. Ideal man would have B. S. in chemistry or equivalent with some experience in textile technology and trade. Excellent opportunity, not only present, but for real future, financial and otherwise. Write Box No. 141

WANTED: CHEMIST — Textile school graduate, for development and field service work. Prefer 2 to 3 years printing and finishing plant experience. National chemical company, metropolitan New Jersey area. Write age, education, experience in detail, salary. Write Box No. 142

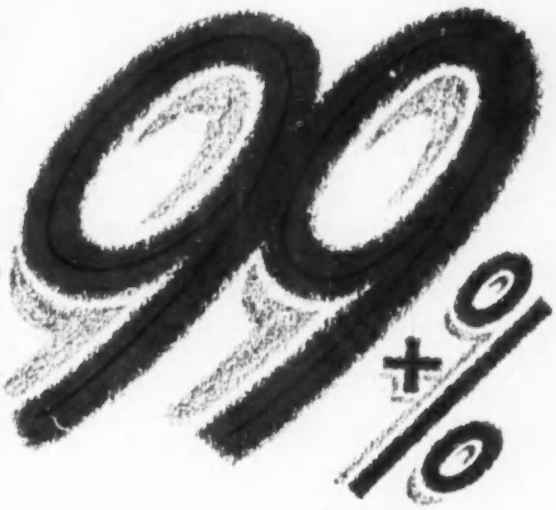
WANTED: PLANT CHEMIST with heavy experience on plant problems on synthetics. Write Box No. 143

POSITION WANTED: Salesman, executive caliber, age 32, ten years' experience dyestuff, chemical and dyeing machinery sales, seeks position as assistant sales manager or sales assistant to top executive. Write Box No. 137

WANTED: TEXTILE TECHNICIAN with experience in laboratory application and evaluation of textile finishes including resins and water repellents. Textile school graduate preferred. Location — Northern New Jersey. Permanent position with excellent opportunity for advancement. Write Box No. 138

WANTED: RAYON TIRE YARN CHEMIST. Progressive chemical manufacturer requires services of chemist experienced in rayon manufacturing and familiar with treatments used on tire yarns. Excellent opportunity for development of new yarn treatments and presentation to rayon manufacturers. Eastern location. State salary, furnish details and photograph. Write Box No. 139

CANADA — Assistant Superintendent (Technical) required for the dyeing and finishing departments of large textile organization in Quebec. Age: 30 to 45. Must have sound knowledge of the dyeing of man-made fibres and have held a responsible position in the industry. Excellent opportunity for first class man. Salary according to qualifications and experience. Group insurance and Pension Plan in operation. Reply in strict confidence to — Dyehouse Superintendent, Canadian Celanese Limited, Drummondville, Quebec, Canada.



pure EDTA

A more concentrated EDTA does more work in your process. Which is why Glyco's 99+% active sequestering agent, the purest EDTA available commercially, should be specified in your operation. No inert salts are present. You pay no premium for the added activity.

The textile industry uses the TETRINE®S in processing cotton, rayon, wool and the synthetics for:

kier boiling	**continuous boil-off**
scouring	**bleaching**
dyeing	**stripping**
re-dyeing	**finishing**

Glyco's EDTA and its salts – the TETRINE®S – are supplied from a new plant specially designed to make these products. Plant – products – personnel – all are geared to eliminating your trace metal contaminant troubles. Send for samples, purity specifications, and our catalog *THE TETRINE®S.*

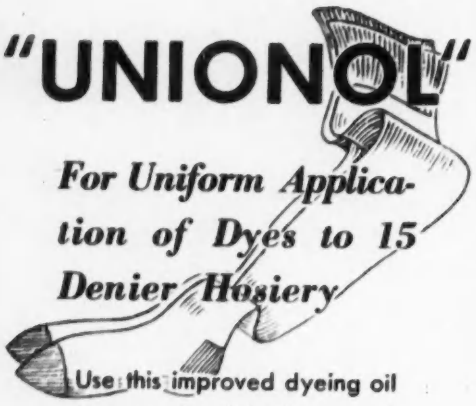
the **TETRINE®S**
Glyco's EDTA

GLYCO Products Co., Inc.
Empire State Building, New York 1, N. Y.

NONIONIC SURFACTANTS • SYNTHETIC WAXES • EMULSIFYING AGENTS

"UNIONOL"

For Uniform Application of Dyes to 15 Denier Hosiery



Use this improved dyeing oil to assure level dyeing—good unions—and to guard against costly rejects and redyeing.

Leatex *"Always Reliable"*

LEATEX CHEMICAL COMPANY
2722 N. HANCOCK ST. PHILADELPHIA 33, PA.

Classified Advertisements

POSITION WANTED: Young man with laboratory and mill experience desires position representing American firm in the Far East, in any branch of textile industry or related field. Previous overseas experience. Textile college graduate. Write Box No. 135

WANTED: TOP-NOTCH RESIN MAN who knows the manufacture of thermosetting resins, installation of equipment to produce them and their application to the textile field. Experience essential but size of company where you have been previously employed is immaterial. Write Box No. 136

TRY

A

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The advanced dye-bath formula that **SCOURS** and **LEVELS** in one operation

Unishade T.M.

DYEING
Ends the costly problem of over-dyeing. Adding more Unishade to the original dye-bath lightens uniformly.

LEVELLING
Achieves fine balance of shade in leg-welt unions and from one stocking to another in each batch.

SCOURING
Rinses out easily, carrying suspended oils and stubborn soils with it.

CONTROL
Toes and welts will not become lighter even during prolonged dyeing.

For Unishade to meet your particular requirements, write our technical department.

CHEMISTS FOR INDUSTRY

Kali MANUFACTURING CO.
427 MOYER ST., PHILADELPHIA 25, PA.

HASTINGS LIGHT FAST VIOLET IRS—(C. I. 1073)

and

HASTINGS LIGHT FAST VIOLET 3RL

Excellent Level Dyeing Properties
Very Good Fastness to Light

Recommended for producing fast shades on Ladies' Dress Goods, Carpet Yarn and Upholstery Materials.

ZINSSER & COMPANY, Inc.
Subsidiary of The Harshaw Chemical Company
ESTABLISHED 1897
Manufacturing Chemists
HASTINGS-ON-HUDSON NEW YORK

Wyandotte gives you quality chemicals plus technical help

Quality — that you can depend on. Close quality control assures pure and uniform chemicals. And you get prompt delivery, thanks to strategically located plants and distributor stocks.

Technical Service — saves you time in solving process problems, and helps increase your production efficiency. Wyandotte works with you on the handling and application of our products. For technical service or product data, mail coupon below. *Wyandotte Chemicals Corp., Wyandotte, Mich. Offices in principal cities.*

Wyandotte Chemicals Corporation, Technical Inquiry Section, Wyandotte, Mich.

Send me data on the products circled:
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☐ Have your representative call on me.

Name _____
Firm _____
Address _____
City _____
Zone _____ State _____

CLIP AND MAIL TODAY!

Wyandotte CHEMICALS
DEPENDABLE SOURCE FOR CHEMICAL RAW MATERIALS

1 **Caustic Soda** — Available as: a liquid in 50% and 74% concentrations, solid, std. flake, ¼" flake, crystal, and powder.

2 **PLURONICS*** — Unique series of 100%-active (including flake and solid) non-ionic surfactants with molecular weights from 1,800 to 8,000. Ether-type structure results in excellent stability to acids, alkalis, electrolytes. Recommended for wool scouring, warp sizing, carbonizing, dye leveling, soaping, and finishing.

3 **CARBOSE* Series** — (Tecinical Sodium CMC) Used for warp sizing. Carbose overcomes many disadvantages of other film-forming materials. Among the *advantages* are: stability, softer warps, desizing, uniformity. More data in AATCC Yearbook.

4 **Chlorine** — Of the highest purity; available in 16-, 30-, and 55-ton tank cars.

5 **Bicarbonate of Soda** — Meets U.S.P. XIV standards. Available in several screen sizes.

6 **Soda Ash** — Five grades: All test 58% sodium oxide or better.

7 **KREELON*** — Economical surface-active agent. Comes in 40% and 85% active-agent forms; flake or powder. Retains wetting, emulsifying, detergent properties in acid, alkaline, or neutral solutions; hard or soft water.

8 **PURECAL*** — (ppt. $CaCO_3$) Pure, uniform; virtually free from iron, magnesium and alkali salts, abrasive materials.

* REG. U.S. PAT. OFF.

He is the textile chemist and dyer who gives eye appeal and buy appeal to thousands of textile products on the counters of stores all over the country. He has built fabrics to sales specifications.

Modern chemistry has made it possible to provide chromatic satisfaction at relatively trifling expense. People of today may easily gratify their color instinct in the clothes they wear and colors of greater beauty and endurance are constantly being made available to all.

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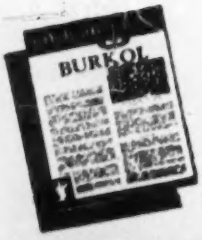

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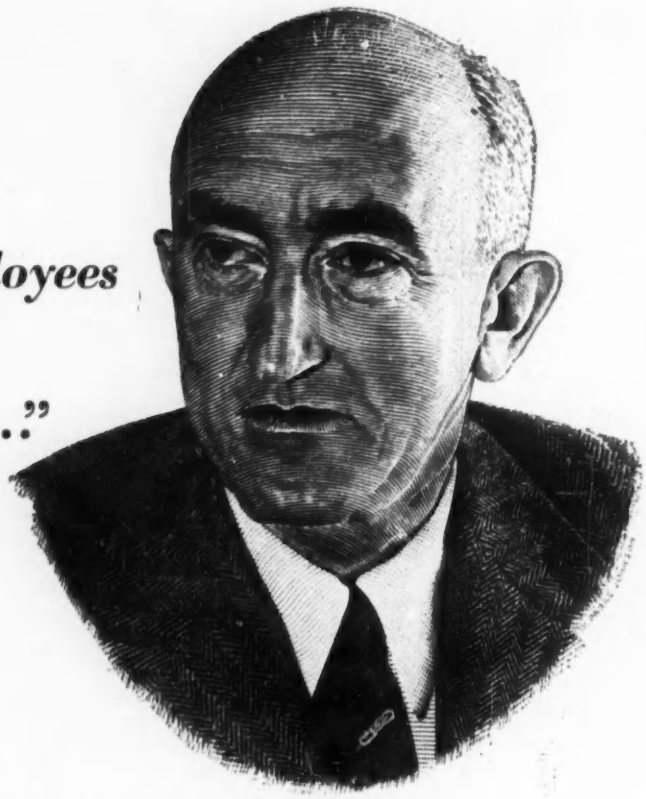

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